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December 20, 2013

Yost & Baill
2300 N. Mayfair Rd, Ste 745
Milwaukee, WI 53226

Attn: Teirney Christenson

Insured:	Scott Blake
Loss Location:	250 Edwards Boulevard Lake Geneva, WI
Co. Claim #:	00-221-215278
Date of Loss:	1/20/11
WGI File #:	59630

INTRODUCTION:

Assignment

On January 20, 2011, Yost & Baill contacted this office about a fire that occurred at the above-mentioned loss location. Yost & Baill asked us to inspect the dryer recovered from the scene and complete an origin and cause analysis. Yost & Baill also asked us to conduct an examination of the Electrolux dryer and address the involvement of this appliance in the cause of the fire in a detailed report.

The subject Laundry Center was sent to our laboratory for the purpose of examination and analysis as to the origin and cause of the fire from Dennis & Associates, Inc. and was received on March 11, 2013. A joint destructive examination was conducted at the Wright Group, Inc. facility in Uxbridge, Massachusetts on May 15, 2013. Present at this examination was Trey Morrison of Exponent representing Electrolux. Present for American Family was Ronald Parsons of the Wright Group, Inc. This joint examination of evidence was conducted using a previously agreed upon evidence examination protocol accepted by all parties.

Background Information:

The evidence examined included a Frigidaire Laundry Center, equipped with an electric dryer. The label had been partially consumed from the appliance, making it impossible to determine the serial number. The model number was FLSE72GCSA. The date code stamped into the cabinet of the appliance was IIB. This date code indicated that the appliance was manufactured in September of 1992. A sales invoice was provided to us for review. The invoice listed that there was Laundry Center with a different model number delivered on 8/31/06. There was nothing to support that this invoice was related to the subject unit. There was no other evidence received for examination.

Methodology

The basic methodology utilized by this author in the investigation of this fire is outlined in NFPA 921 Guide for Fire and Explosion Investigations, 2011 edition. The basic methodology utilizes the scientific method as outlined in chapter 4.3 of NFPA 921. Section 3.3.144 defines the scientific method as "the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of a hypothesis." The use of the scientific method during fire investigation analysis is mandated in NFPA 1033, Professional Qualifications for Fire Investigator.

The problem was defined as to determine the cause of the fire and to determine whether the subject Electrolux dryer was involved in the fire cause and/or to identify any defects within the Electrolux dryer that are related to the fire cause. To accomplish this, data was collected in many forms. That data was analyzed. From the analysis of the data, hypotheses were developed and tested. A peer review procedure was utilized throughout this process in this manner. Conclusions would then be formed with the final hypothesis selected as to the origin and cause of the fire.

To determine the cause of the fire, the competent heat source that caused ignition of the available fuel and the first fuel were identified. Further, this portion of the analysis addresses the factors that brought the ignition source and the first fuel together. NFPA 921, 2011 Edition, Section 18.1.1 states:

> *The determination of the cause of a fire requires the identification of those factors that were necessary for the fire to have occurred. Those factors include the presence of a competent ignition source, the type and form of the first fuel ignited, and the circumstances, such as failures or human actions, that allowed the factors to come together and start the fire…*

According to NFPA 921, and all other teachings known to this writer, a credible cause determination is based upon all of the available evidence and is achieved through the convincing elimination of all other reasonable potential causes within the appliance of origin, given that the only remaining causation factor is consistent with all known facts. This analysis of the potential ignition sources within the subject appliance is considered in light of all of the information provided to date and their relationship to ignition and fire dynamic principles.

Executive Summary:

Our investigation revealed that the fire originated within the clothes dryer portion of this Electrolux electric Laundry Center. The ignition source was the energized heating element located behind the dryer drum. The first fuel ignited was lint collected behind or on the rear of the drum. The ignition event was the direct result of the lint that collects at or near the heat source, within the area between the rear of the drum and heater housing, dislodging and igniting when the lint contacts the energized heating element during operation. This event was allowed to occur because of the defective design of the Electrolux dryer in allowing a fuel (lint) to accumulate at or near a competent heat source (heating element). The ignited lint was carried through the dryer drum and ignited additional lint that was collected in the area of the lint screen and trap duct. These components are made of plastics that provided additional fuels to be ignited by the burning lint, which can enable spread of fire out of the cabinet to adjacent items. This fire event occurred because the defective design of the subject Electrolux dryer allows for lint to collect behind the drum in direct proximity to the heat source where it is neither visible nor accessible by the user.

The design and warning of the subject dryer was unreasonably dangerous and defective for the following reasons:

- Electrolux knew or should have known that the clothing in the drum and the lint that collects within dryers are combustible and that the heat sources within dryers, both electric and gas models, have sufficient heat energy to ignite these combustible materials.

- Electrolux should have better separated potential ignition sources from the first fuels within the dryer through the use of a more appropriate and safer dryer design used by other manufacturers, as opposed to the subject dryer design.
- Electrolux breached the duty of basic Safety Engineering principals by not properly designing adequate guards or safety devices in their existing dryer design type to protect against known flaws in the safety of the subject design.
- A simple design change, by installing an engineered guard in the diffuser pan of the gas dryer design, would further separate the lint that is known to accumulate in the gas diffuser pan from the heat source, in either the existing gas design or proposed redesign of the electric dryer with the heating element relocated. This design would significantly reduce the known problem of fires caused by the ignition of lint by the heat source.
- A simple design change, by using their existing gas dryer design and replacing the gas burner assembly with a package style heating element found in other manufacturers' designs would eliminate or significantly reduce the fire hazards associated with the electric dryer design. This relocation of the heating element would remove the heating element from its close proximity to the rear of the drum and the combustible lint and clothing that is known to collect there.
- Electrolux has since changed the design of the their gas and electric dryers for their newer models, which is similar to that of dryers manufactured by many of their competitors and also is the most common dryer design type on the market today. This design concept was available at the time the subject clothes dryer was manufactured, as other manufacturers have used it for over 50 years.
- Simple design changes, such as replacing plastic components with steel components, or by using plastics with higher degrees of fire resistance ratings would have reduced the potential for burning lint or clothing to ignite those components as well as reducing growth fuels that allow the fire to grow and spread from the cabinet. Electrolux has tested fire containment and found that molten plastic escaped the cabinet during testing. Even with these results, Electrolux intentionally chose to use a large amount of plastics that met only the minimum specifications of the voluntary standards. Conversely, GE required Electrolux to use plastics with better fire resistive properties in the GE branded

dryers based upon the same fire containment testing, even though Electrolux chose not to in their own dryers.

- Electrolux failed to follow the engineering principals of Safety Engineering. Electrolux has chosen to place the burden of hazard isolation on the user by utilizing warnings and instructions in place of redesigning the product to eliminate the hazard or installing engineered guards and/or safeties.
- Electrolux failed to recognize that it is reasonably foreseeable that the user may overlook any instructions as to regular maintenance and failed to incorporate engineered guards and safety devices to prevent or reduce the risk of property damage, personal injury or death from fire. The use of warning labels and safety instructions should never be the primary preventative measure in regards to fire safety.
- There is no specific warning that lint accumulates behind the drum in proximity to the heat source in areas that cannot be observed by the user, or that the lint that accumulates in this area poses a significant risk of fire.
- There were no warnings on the product for the installer advising not to use flexible foil duct to vent the appliance.
- A safety device, such as an operational cycle counter with a reminder light to service the dryer after a specific number of uses could have been employed to actively notify the user as to the need for service and as a safety device to prevent fires should the need for service be ignored. This technology has been in use in other applications for over thirty years. Since 2005 or earlier, some clothes dryer manufactured by Electrolux, both the subject Ball-Hitch design and the alternative Bulkhead design, incorporate this same principal and evaluate reduced airflow by monitoring the high limit safety device. However, in earlier models, this monitoring system was only available in the "good" and "better" dryers and was not an option on the base models. Electrolux could have added this type of safety device and could have even designed in a lockout feature to shut the dryer down if the warning light was ignored by the user and the service period was exceeded, which could only be reset by a trained servicer.
- A safety device, such as an airflow monitoring system could have been employed to actively notify the user as to the need for service and as a safety device to prevent fires should the need for service be ignored. Currently, most clothes dryer manufacturers

currently use this detection system. Whirlpool's Cabrio line of residential clothes dryers incorporates "airflow detection capabilities" which monitors the exhaust system and provides an error code on the dryer control console to actively warn users of a restricted exhaust condition. Electrolux could have added this type of safety device and could have even designed in a lockout feature to shut the dryer down if the warning light was ignored by the user with conditions of poor airflow, which could only be reset by a trained servicer.

- Electrolux did not instruct owners or servicers how to conduct the required regular maintenance of their dryers. The Service Manual for 27" Gas and Electric dryers authored by Electrolux for use with the maintenance of their dryers does not contain any specific instructions on the required steps necessary to conduct the 18-month maintenance recommended to prevent lint fires.
- The Electrolux dryer in its subject design was unreasonably dangerous and defective because it posed a risk of property damage or serious injury without adequately warning of the risks or by failing to use an adequate guard or safety.

These conclusions and opinions are based on an examination of the subject Laundry Center, comparative analysis of the subject Electrolux 5.7/5.8 Cu. Ft. dryers compared to the new 7.0 Cu. Ft. dryers manufactured by Electrolux, numerous exemplar Electrolux dryers of the same design types, review of the User's Guide, Installation Instructions, Service Manuals and other documents related to dryers manufactured by Electrolux, other dryers manufactured by Electrolux's competitors, operational and fire testing of dryers of various makes and models, and our experience, training and knowledge as a fire investigators and forensic consultants.

Review and Summary of Lake Geneva Fire Report:

The Lake Geneva fire department was dispatched to 250 Edwards Blvd. on January 21, 2011 at 7:48am with the report of smoke in Unit 116. Upon arrival at 7:55am crews entered the second floor Unit 116 and reported moderate smoke conditions. All other units within the structure were evacuated. Crews approached Unit 115 – directly below the reported Unit 116 - and noticed a smoke odor from within. Unit 115 was opened and crews immediately encountered heavy black

smoke and moderate heat conditions. Initial observations were of a fire in a dryer of a combination washer/dryer appliance. The fire was extinguished in the dryer using a water can as an attack line was pulled into the structure. Fire had extended out of the utility closet into the hallway and living room areas. Ceilings were pulled in the hallway and living room to check for possible fire extensions. Remaining crews cleared the scene at 9:37am.

Review of Dennis & Associates, Inc. Report Dated 6/17/1:

The Wright Group was provided a copy of Dennis & Associates, Inc. destructive examination report conducted and produced by Dennis Dyl. Mr. Dyl began his report by saying that he had removed the Electrolux Laundry Center from the apartment on March 15, 2011 following the joint site examination. He stated that the washer/dryer closet was found slightly fire damaged and an examination of the laundry center found evidence of fire damage to the dryer section and controls while the washing machine was undamaged. The dryer exhaust duct system was examined and no significant amount of lint was accumulated within. Engineering Systems, Inc., Electrolux's expert, measured the duct backpressure using a digital manometer and recorded backpressures of 0.54 to 0.57 inches of water column. This indicated that permanent duct for the subject Laundry Center was well below the maximum of 0.75 inches of water column backpressure allowed in the Installation Instruction. This measurement could not have included the flexible foil duct that connected the dryer to the rigid venting, as that had been partially destroyed during the fire. Scene photographs were not provided with Mr. Dyl's report. We would request that Electrolux provide all photographs, diagrams, notes and any other information regarding this loss that would be in the possession of their expert, Engineering Systems, Inc. We reserve the right to examine and evaluate the test equipment used by ESI to record the backpressure measurements at the scene.

A destructive examination of the laundry center was conducted on May 18, 2011 by Dennis & Associates, Inc. A model number of FLSE72GCSA was discovered, however a serial number could not be found. The interior drum finish had been consumed and the remains of bath towels were located inside. The control wiring was fire damaged and arcing on the left side of the control panel wiring was observed. Dennis Dyl removed the top of the cabinet and examined the

heating element and thermal safety. The heating element was intact though covered in soot, and the high limit was mechanically broken. The high limit contacts were closed and showed no evidence of damage, while the thermal safety was found in the open position. The motor was fire damaged and the aluminum windings were melted. He stated that the damage was greater on the left side closest to the cabinet. The polymer exhaust duct had melted and the remains were found in the bottom of the dryer cabinet.

Mr. Dyl concluded in his report that the exhaust duct system showed no evidence of excessive lint accumulation. The fire damaging the dryer and Unit 115 occupied by Ms. Lisa Aaron originated within the cabinet of the dryer. Dennis Dyl determined that lint in the dryer cabinet was ignited by the heating element. The fire within the dryer caused arcing and damage to the dryer, dryer closet and apartment.

Review of Karen Starck Deposition, Dated 10/3/2013

The following is a review of Karen Starck taken on October 3, 2013:

- The fire occurred January 20, 2011
- She does not recall who the tenant in unit 115 was, where the fire occurred, or was at the time of the fire.
- The tenant in unit 116 learned of the fire and reported it. The tenant in unit 115 was not home at the time of fire discovery.
- She has worked for Blake Capital Corp. for 24 years and is currently the Senior Vice President.
- Blake Capital is a property management company that oversees almost 3500 apartments and two office buildings. She is not involved in the commercial buildings, only the residential.
- Blake Capital is the managing partner. They own all of their properties. They have 15 different properties and each has its own site manager. She oversees the managers.
- The fire occurred at The Ridges of Geneva East, LLC.
- The property manager at The Ridges of Geneva East is Stephanie Goldsmith. Ms. Goldsmith no longer works for Blake Capital.

- She would visit the property approximately once a week at which time she would meet with the Managers and maintenance people. She walked the property, including the vacant apartments, signed leases and dealt with any difficult problem residence or complaints.
- She was usually not involved with any complaints related to appliance issues. If an appliance needed maintenance or repair, it would be handled by the property manager and the maintenance person.
- There was one maintenance person on site at the time of the fire. That person is no longer there and she could not recall his name.
- She has a maintenance supervisor that oversees a variety of properties, including The Ridges.
- Every rental unit came with a laundry center as part of the lease. There was no extra charge for that appliance.
- They did not supply tenants with any operational literature or related items for the laundry center. They did not supply that because using the appliances was pretty easy and self-explanatory.
- The only instructions the tenants are given in respect to operating the laundry centers was to keep the closet door open when running the appliance and empting the lint trap clean. They did not specify how often to clean the lint trap because it would depend on usage.
- The laundry centers were in a closet with a wooden by-fold door. The door was not vented.
- There are 120 rental units at The Ridges.
- The laundry center in unit 115, were the fire occurred, was located in the closet. She estimated there was approximately 5 inches of clearance to the closet walls on either side, between the walls. On top she estimated there was approximately 3 feet of open space.
- Each building in the complex contains 8 rental units and is constructed of 2 levels. Each individual unit is a single story.
- Unit 115 was approximately 1,000 square feet with 2 bedrooms and 1 bathroom.
- The decision for appliances is based on a conversation with their distributor. The decisions are based upon which appliances can fit in the space and which appliances are good. They attempt to use the same appliances for all of their properties. In The Ridges, they have 2 different brands of laundry center, Frigidaire and GE. She could not estimate how many of the 120 apartments at The Ridges have Frigidaire laundry centers, but possibly more than half.

- They have had other problems related to the Frigidaire laundry centers, but with the exception of the subject fire, have never had a fire with the Frigidaire units.
- When asked if there were maintenance problems or operational problems that she was referring to, she stated the problem was with the design. She stated the product is really cheap and does not last. The parts are not holding up. She had an argument with her distributor the day prior to the deposition about the many problems they have had with them.
- Their distributor is Kennedy and Hahn. They were recently purchased by American TV.
- She does not know how long the subject laundry center was in unit 115 prior to the fire, nor did she want to guess at the age.
- She estimated that they purchased approximately 200 laundry centers per year for all of their properties combined.
- The laundry centers were delivered and installed by the distributor either Kennedy and Hahn or American TV. She believes this particular dryer was installed by Kennedy and Hahn.
- Before a dryer is installed, they clean out the closet and clean the whole venting system by the attic. This was done by maintenance personnel.
- The maintenance personnel had no training or certifications in dryer vent cleaning. They were trained in house by her maintenance supervisor.
- They used vacuums to clean out the venting.
- Their maintenance supervisor did not have any specific training on vent cleaning. No outside or 3rd party training.
- None of the venting in the building had been replaced in the building since it was constructed. The exception is the flexible transition duct that connected the laundry center to the permanent duct.
- The permanent ducting goes up to the attic. There is a collection box in the attic for the dryer vents. From there it vents outside.
- The flexible transition duct that connected to the dryer to the permanent ducting was flexible foil. She recalled they changed the requirements a few years back and they switched to that material at that time. The prior flexible ducts were plastic, but the recommendation was to discontinue those.
- The transition to use all flexible foil ducts, as opposed to plastic, was done prior to the fire.

- She estimated the length of the flexible foil duct connecting the laundry center to the permanent duct was approximately 2-3 feet in length.
- She believes at The Ridges, the permanent duct connection is at the closet ceiling, or on the wall at ceiling level.
- She had last seen the permanent ducting going through the wall in the attic when the building was constructed in 1992.
- Unit 115 is located on the 1st floor. The venting goes up through the wall, through the 2nd story, and up to the attic.
- She does not know if the 1st and 2nd floor units share a vent or if they have individual vents.
- She has heard the maintenance personnel discuss the collection box in the attic. She is unsure what the collection box is. She has heard the maintenance people talk about cleaning the collect boxes out.
- Frank Santos was the Maintenance Supervisor at the time of the incident.
- They were not given any installation options by the distributor. It was the distributor's decision, who installed the appliances, to use flexible foil to connect the dryer to the permanent ducting.
- There was no specific schedule for duct cleaning by The Ridges maintenance personnel. They would typically do it in the slower winter months.
- They used a vacuum cleaner to clean out the collection box in the attic and the tubing that went down through the walls. She believes their cleaning was affective because they never had a lot of built up within the dryer vents.
- When tenants moved out and apartments turned over, they would clean out the apartments and clean the appliances at the same time. The maintenance on the dryer at the time of turnover included removing the lint screen and using a vacuum to remove lint from the lint trap below the screen. They would also vacuum the lint screen itself. They cleaned the interior of the cabinet by washing it off. They did not disassemble the laundry center for any reason during this cleaning.
- The only time maintenance staff at The Ridges would disassemble the dryers would be when there was maintenance call by the tenant. If there was a complaint that the dryer was not heating, or was not tumbling, the maintenance staff would take it apart and fix it. This would be conducted by the onsite maintenance man, whose name she could not recall or Frank

Santos, the maintenance supervisor. Those are the only 2 people that would ever repair the dryers at The Ridges.

- When asked if they had any special qualifications or training or dryer repair, she stated that Mr. Santos had been repairing them for 20 years and he trains his maintenance staff. She does not believe Mr. Santos has any formal training.
- If the individuals on the maintenance staff don't know how to maintain the dryer upon being hired, they get trained by another maintenance person, typically Mr. Santos.
- Mr. Santos has been with the company for approximately 12-15 years.
- If a tenant had an issue with a dryer, they would call the management office at The Ridges. The management office would notify Mr. Santos or his maintenance person of the problem. She would be called regarding a problem with the clothes dryer.
- When informed that the tenant, Lisa Aaron, had commented that the clothes were taking longer to dry, she stated that complaint is common. The reason is because many tenants are familiar with full sized washer and dryer pairs. The laundry centers are not as powerful or as large of a capacity.
- Many times that they have investigated the complaint that the clothes were not dryer, they came in and found that the washer and dryer were stuffed full of clothes.
- If a tenant complains of extended drying times, there will be a work order written and maintenance will respond, either Mr. Santos or his assistant.
- She does now know if the tenant in unit 115 ever filed a complaint about the laundry center in that unit. They would still have a work order but she would have to go through 3 years of old records to find them.
- They normally keep records for 3 years on a computer log. At The Ridges they had problems with the computer and 1 crashed. She may not actually have the history but would have to check.
- The subject laundry center had been replaced sometime before the fire and she believed it was a newer unit. Based upon the records produced to date, the dryer was no more than 5 years old at the time of the fire. She does not know if she has records for that unit going back that far.

- The only time they use a 3rd party maintenance provider is when there are warranty issues on an appliance in the first year. After the warranty expires their own staff maintains all of their appliances. If it cannot be repaired, they typically just replace it.
- She believes the receptacles for the laundry center are located in the closet behind each unit. She does not know of any electrical work done on unit 115 in 6 months prior to the fire.
- Based upon the post fire photographs of unit 115, the connection between the flexible foil transition duct and the permanent duct occurred at the ceiling of the closet.
- The development at The Ridges was built in 2 phases, phase 1 in 1992 and phase 2 in 1994. Unit 115 would have been constructed in 1994.
- The tenant in unit 115 at the time of the fire was Lisa Aaron. After the fire they moved her to another apartment, where she stayed for approximately 6 months before moving.
- She believed that Ms. Aaron only lived in unit 115 for less than a year at the time of the fire.
- She had never received any complaints about Ms. Aaron prior to the fire.
- She does not know if Ms. Aaron smoked. Tenants are allowed to smoke in the units.
- She does not know if they get the instruction materials provided with the appliances from the distributor. She is not there when they unbox them or deliver them.
- It has been at least 10 years since the last time she was present during the delivery and installation of an appliance.
- She is not read any product literature in the last 5 years. She stated the instructions have stayed the same.
- She does not recall ever seeing the warning label on any of the laundry units.
- She believes she has been the installation check list that comes with the laundry centers. She had never read it because they have no involvement in the installation.
- She is not familiar with the item on the installation check list that indicates not to use plastic flexible or metal foil duct.
- She stated that due to the installation in the closet, they cannot use a completely ridged venting system.
- The length of the ducts would have been addressed as part of the construction of the building. They have made no changes to the ducting since the time of construction.

- There has never been any evaluation or consideration to change the venting configuration since the building was constructed.
- She assumes that Mr. Santos may have read the installation instructions, but she is not sure as the distributor installs them.
- She has been the sole purchaser of all of the laundry center units for the Blake Capital Properties, even before Scott Blake purchased the properties. She estimated for approximately 20 years. 24 years for Blake Capital and the entire history of The Ridges.
- In the past 10 years she has never been given any options about the installation by the distributor who installed the laundry centers and was never shown the type of materials that the distributor planned to use to install them.
- She does not know if the distributor replaced the flexible tubing with a new one each time a new laundry center was installed.
- She believes the universal change from using flexible plastic vents to flexible foil vents occurred at least 10 years ago.
- Since the maintenance staff only cleans the lint screen and interior of the lint trap when apartments get new tenants, it is possible that there can be years between those cleanings.
- The Ridges are more of a transient market. They do not have many long term tenants. She believes the average length of time a tenant would live there would be approximately 2-4 years.
- It was her opinion that the maintenance staff would address problems with poor venting when tenants compline that the dryer was not drying properly. The symptoms observed during the use should dictate the maintenance needed.
- It was possible the tenants could experience longer than normal drying times but not call to report the problem.
- She has never seen any warnings on TV or a newspaper, other than those documents that they examined during the deposition that warns about the likelihood of fires in dryers.
- She has never seen any news articles or TV shows regarding cleaning dryers.
- She does not know the exact clearances around the dryers. She assumed there would be a few inches of space between the back of the dryer and the back wall of the closet.
- If the dryer was pushed back the flexible foil vent could be constricted.

- When she responded to unit 115 after the fire, the fire department had already removed the laundry center from the closet. The post-fire photographs show that the venting was still sticking out and was not crushed.
- She does not know if the subject laundry center was ever disassembled prior to the fire for any reason.
- She is not aware of any problems with the subject laundry center reported prior to the fire.
- The distributor, Kennedy and Hahn or American TV handle all the warranty documentation and record keeping.
- She does not know how frequently the laundry center was used on a weekly basis and she has never spoken to the tenant about that. She knows the tenant had 2 children so she assumed it subjected to frequent use.
- She believed she observed clothes in the dryer after the incident. They appeared to be regular clothing. The fire department had to remove them from the dryer when she first saw them.
- She assumed the dryer may have been in use at the time of the fire, although Ms. Aaron reported the dryer was not on at the time.
- She does not know if the dryer was used on the day prior to the fire.
- The fire was discovered in the early morning, approximately 7-7:30 a.m.
- In the weeks prior to the fire, they received no complaints related to the subject laundry center or any unusual electrical problems in the building.
- The fire was discovered by the upstairs tenant who observed smoke and called the property manager. She does not know if the upstairs neighbor also called 9-1-1.
- She arrived at the property at approximately 2 hours after being notified of the fire.
- While inspecting the fire she spoke with the residents' mother and father who were both there. Ms. Aaron showed up later.
- She believed the dryer was taken off site by Electrolux after the fire. The laundry center had stayed onsite in a secure maintenance garage at The Ridges for approximately 5 months until they were told they could release it.
- She does not know what happened to the load that was in the dryer at the time of the fire or the venting that was removed. She does not know how much of the venting was demolished or replaced as a result of the fire.

- After the fire, several individuals inspected the laundry center while it was still in their possession. This included a representative from American TV or their insurance company, someone from Frigidaire, someone from American Family Insurance and someone from the tenant's insurance company.
- Although some of the permanent venting may have been changed after the fire, the orientation should still remain the same.
- They have not made any changes to their policies involving instructing the tenants to use the laundry centers and have not given the tenants any additional documentation.
- Ms. Aaron was moved to another apartment after the fire. She moved off the property approximately 6 months later. Her move had nothing to do with the fire, use of appliances or the cleanliness of the unit.

Review of Scott Blake Deposition, Dated 10/4/2013

The following is a review of the insured, Scott Blake, taken on October 4, 2013:

- He owns the property called The Ridges at 250 South Edwards in Lake Geneva. That address refers to the location of the club house.
- He did not recall the fire was located in unit 115 and he does not recall the date of the fire.
- He is the sole owner of Blake Capital Corporation, which came into existence in 1988.
- Blake Capital Corporation is in the business of property management, development and acquisition of multifamily apartment communities and some office buildings. They also play minor role in 3rd property management.
- Blake Capital Corporation does not own any real estate. The Ridges, where the fire occurred, is owned by Ridges Limited Partnership. He is the managing partner of that partnership.
- He has been involved with The Ridges of Geneva East through all 3 phases of construction. The 1st phase started in 1994, the 2nd in 1996, but he does not know when the 3rd phase was.
- As part of his deposition preparation, in response to the subpoena asking for document production, he searched his email and found 1 related to the fire. This was an email between Karen Starck, dated January 2011, a couple days after the fire.
- Karen Starck is the Senior Vice President in charge of property management. At the time of the fire, all the property managers at the various properties reported directly to her.

- In respect to the choices of appliances installed at The Ridges, when the developed the buildings they used a company called Wimmer Brothers Construction. They would have recommend appliances at the time of construction.
- Karen Starck or people below her would have also been involved in the purchase of the appliances to be placed in the units.
- He had no involvement in the construction of the units, besides aesthetics decisions. He did not have any involvement as it related to the laundry appliances.
- He had no involvement in the design of the dryer venting. He believes that would be the decision of the architect, the general contractor or the individual subcontractor.
- They refer to all Laundry Centers as "unitized". It is a single combined unit with a washing machine on the bottom and a dryer on top that fits into a closet.
- It was a recommendation from the architect that they use a space saving Laundry Center as opposed to creating a whole laundry room, as it is more fitting for an apartment application.
- He does not recall the specifics on whose decision it was to choose the type of door used on the laundry closets.
- He does not typically get field complaints from any tenants.
- Neither he nor any of his management team at Blake Capital was ever given options as to how the installation would occur of the Laundry Centers and what materials were to be used.
- They relied upon Electrolux dealer to deal with the logistics related to the installation and installation materials.
- The dealer/distributor was Kennedy and Hahn. They are owned by American.
- Karen would have been the corporate person who dealt with the appliance distributor.
- If a dryer needed significant repair or replacement, they would have called Kennedy and Hahn. If it needed minor repair, their maintenance person would likely perform them. Their maintenance staff conducted minor repairs, but not frequently.
- He does not get consulted on what level of repair the maintenance staff is capable of performing versus what needs to be repaired through the distributor.
- He does not know the name of the tenant who was living in unit 115 at the time of the fire, or the person in unit 116 above. He does not know anyone's name that lives at The Ridges.
- The only detail he knows about the fire was that it was a dryer fire.

- The remediation or restoration would have been coordinated through Karen Starck.
- Any problems with this dryer or any Laundry Center's at The Ridges would have been reported to management at that location or Karen Starck. He does not recall of anything being reported to him.

Review of Frank Santos Deposition, Dated 11/1/2013

The following is a review of Frank Santos, the Maintenance Supervisor, taken on November 1, 2013:

- He did not have any involvement on the day of the fire in terms of inspecting the unit or anything, because he was not working that day. He was off for 3 months at the time of the fire due to back surgery. He went on leave on January 10, 2011.
- He was not involved in any repairs done to the fire unit. He became aware of them after he returned.
- He has been employed by Blake Capital for at least the past 10 years and is currently the Maintenance Supervisor.
- He is the Maintenance Supervisor for all of the properties for Blake Capital. He was not specifically in charge of maintenance at The Ridges at Lake Geneva, the maintenance staff located there were the main people in charge.
- At the time of the fire, he believes there were 13 or 14 different properties he managed the maintenance staff's at.
- He estimated that in 2010 he may have visited The Ridges on average of once or twice a week if there was a problem.
- There were maintenance personnel on site at The Ridges. He could not tell you how many maintenance staff there was, due to employee turnover at the time. Typically there was just one staff member there. He does not recall who that person was or how long they had been stationed at The Ridges at the time of the fire.
- In respect to his maintenance duties that were hands on, he would only go when they needed assistance from another person or if their work load was too extensive.
- His supervisor was Karen Starck.

- There was no one that stood in for him during his medical leave. If someone at The Ridges needed help, another maintenance person from a different property would have helped them.
- The maintenance staff at The Ridges was not directly supervised by him on a regular basis; they were supervised by the office staff at The Ridges, by whoever was the property manager at the time. He does not recall who that person was at the time of the fire.
- He is not provided any training to the maintenance personnel at The Ridges. Most of the maintenance staff already had hands on experience when they are hired. There is no ongoing training protocol.
- If a tenant experiences a maintenance problem or concern, they would contact the rental office at The Ridges and speak with the manager or leasing agent that was there. That person would contact the maintenance personnel on site. If the maintenance worker needed additional help, that person would contact Mr. Santos.
- He has never met with any new tenants at The Ridges and explained how to operate or maintain the appliances in their unit.
- If the tenant said that someone instructed her from The Ridges, he would not know who that person would be.
- After graduating from High School he went to work at Wisconsin Steam, where he worked on steam cleaners and pressure washers. He had on the job and factory training on steam cleaners and pressure washers.
- In the past 20 years that he has worked at Blake Capital, he has had the opportunity to repair dryers and laundry centers on the premises owned by Blake Capital. In the past 5 years he estimated that he has conducted those repairs a double dozen times.
- In general, his repairs included replacing bearings or felt seals, timers, motors and water pumps.
- He taught himself to conduct those repairs based upon his general mechanical experiences and common sense.
- He does not have any formal training on repairing dryers.
- He never conducted any maintenance or repairs on the Laundry Center that was located in unit 115 prior to the fire. He did a lot of work on equipment at The Ridges, but generally recalled which units they were. He did not do much work in that section of The Ridges.

- He does not keep a log of which units he worked in and what work was performed. There would be work orders for any problems notes in any units.
- In addition to repairs he conducted on Laundry Centers, washers and dryers, he has installed windows, garage doors, garage door openers, siding and light fixtures. He has also repaired dish washers.
- All of the units at The Ridges have Laundry Centers. He believes they were installed when the buildings were built, before he began working there.
- The work he performed in the Laundry Centers would have been by himself, or in conjunction with another on-site maintenance person. In the past 5 years, he recalled conducting those repairs with Ashton and Jason.
- He has never been involved in cleaning Laundry Centers, washers or dryers.
- Blake Capital does not hire any separate entities to perform cleaning of the Laundry Centers that he knows of.
- He does not have any involvement in the scheduling of maintenance or repairs on washers, dryers or Laundry Centers. That would go through the main office at The Ridges.
- He does not have any involvement in the purchasing of Laundry Centers. That would also go through the office at The Ridges. The property manager would typically place the orders directly through the distributor.
- While he has not ordered appliances at The Ridges, he has for other properties. That occurred on smaller properties that did not have on-site staff.
- He directly over sees the maintenance at only 1 property, South Shore Point.
- He has never gone to the distributor or any properties to look at appliances that may be purchased.
- He has never had any involvement in the installation of a dryer or Laundry Center at the Blake Capital properties.
- American, the company they purchase the appliances from, handle the installation of the dryers and Laundry Centers. It is American's decision on how to install them and what materials used to vent them. He has no involvement in those decisions.
- He has never replaced any venting for the dryers or Laundry Centers at The Ridges. He is not aware that is something that ever had to be done. The maintenance on staff at The Ridges may know that.

- He estimated the laundry closets where the laundry centers were installed at The Ridges measured at approximately 30 inches by 27 inches. He does not know the exact dimensions of the laundry closets in unit 115, although they are all approximately the same size, give or take a few inches.
- There are 225 units at The Ridges in 15 buildings each with 2 floors, and there are 8 units per building.
- Unit 115 was located on the 1st floor and 116 was located on the 2nd floor just above it.
- He estimated that in general, the Laundry Centers have approximately 2-4 inches of clearance on either side. To the rear, the dryer half and washer half are off set. The dryer half did not have much clearance behind it, if any, but he estimated there was approximately 3 inches of space between the rear of the lower washer and the wall behind it.
- He was working for Blake Capital the first time he ever repaired a washer, dryer or Laundry Center. There was no one over seeing his work or training him at that time.
- The doors on the laundry closet were hollow core bi-fold door. They are not vented.
- He does not have any knowledge about the purchase of the subject Laundry Center from unit 115. He does not know when it was purchased or how old it is. It was probably purchased through American. He does not know who selected it or who paid for it.
- The vent system would have traveled from the first floor unit up into the attic and connected to a collector box located in the attic. The duct within the wall was a solid pipe that would have ran from the first floor through the second floor.
- He assumes there is only 1 elbow, located on the bottom, as the connection to the permanent duct from the Laundry Center accurse at the wall.
- The Laundry Center was connected to the permanent duct at the wall with a flexible transition duct. It could have been a flexible aluminum duct. He could not say exactly what was installed in unit 115 because he never had the opportunity to see it.
- He has replaced some of the flexible transition ducts in properties. The flexible duct used was a flexible aluminum pipe that stretched from 2 feet to 4 feet. It was not aluminum foil, it was actual aluminum.
- He has replaced numerous flexible transition ducts, but he could not recall if he ever replaced the 1 in unit 115 prior to the fire.

- No one instructed him to use the flexible aluminum duct. It was his decision because he did not like the foil duct. He believed the aluminum duct was better and more durable.
- When replacing dryer transition ducts, he would typically purchase them from Home Depot.
- He has never read the owner's guide or user's manual for the Laundry Centers at The Ridges. He only looked at 1 briefly and did not physically read through the whole thing. He did not read it fully because there was not a lot of information in there. When he was looking through it, he was specifically for parts numbers, as he was using it for a repair and not referring to it as a user.
- He has seen manuals for the Laundry Centers in people's apartments. When people move out, they typically leave them behind, possibly in their kitchen drawers. He does not do anything with those manuals; he leaves them in the drawer.
- He does not read the installation manuals, as he does not install the appliances.
- He has never used flexible plastic venting on dryers. He has never seen anything happen to it, but his decision was based on the fact that it is plastic and cheap.
- He never had any problems with the aluminum venting. He did not care for the foil because it was too flimsy. Those 2 types of materials look different.
- He could not recall which specific manuals he saw in people's apartments, either user guides or installation instructions. He typically sees manuals lying around all the time in almost every unit. Generally those manuals were left behind from when the appliance was installed. He could not say that they were always left behind at the time of installation.
- He does not have any involvement in any maintenance of a Laundry Center that is customary when a tenant moves out. The maintenance personnel at The Ridges would.
- When a tenant moves out, the maintenance personnel at The Ridges go through the whole apartment. In addition to cleaning and cosmetic issues, all of the appliances are run and checked out before a new tenant moves in.
- He has never performed any inspections of Laundry Centers himself at The Ridges or at any other Blake Capital property.
- He does not know if anyone at The Ridges, either maintenance or property management, inform tenants about the manuals or instructions for the appliances.
- In respect to the permanent ducting running from the 1st floor closet into the attic, there is an elbow in the wall followed by approximately 20 feet of straight ridged metal pipe running up

to the attic. He believes the length is approximately 20 feet or slightly longer. He believes it is made up of (2) 10 foot lengths of ridged metal piping.

- In the attics at The Ridges, the ridged metal ducts enter the open attic and connect to a collection box. There are 4 ridged ducts from the dryers connected into each collection box. From there, a single pipe connects the collection box to the exterior vent through the roof.
- There is usually 1 additional elbow in the attic before the collection box.
- The collection box is approximately 1-1/2 feet by 1-1/2 feet in size. There is no screen in the collection box. It is open. The box has 5 holes in it and it is made out of 24 gage sheet metal.
- When he has observed the interior of these collection boxes he has observed a little lint in there.
- The buildings are divided in half. There are 2 collection boxes in each half of the attic, each responsible for 4 units, 1st and 2nd floor in each half.
- He could not say if each unit, both top and bottom floors, have individual vent pipes, or are combined in the wall. He has never seen any diagraph related to the exhaust venting.
- The exterior vent discharges through the side of the collection box and vents to the outside at the side of the roof.
- He is not involved in the cleaning of the venting at The Ridges. The maintenance staff onsite conducts cleaning of the venting once a year. He has never seen them do this cleaning. He does not believe they hire an outside maintenance contractor.
- Not all of the other Blake Capital properties have Laundry Centers. He does not believe any of the venting layouts are similar with any of the other Blake Capital properties.
- He has been involved in cleaning dryer vents at other locations. The last cleaning he performed was done approximately 1 month prior to the deposition on a 2nd floor unit. He connected a leaf blower to the vent and turned it on to blow out the vent. In this property, each dryer has its own vent vents directly out of the roof.
- He conducted this vent cleaning because he repaired a dryer at that location. To repair the dryer, he replaced the bearing and felt.
- Many of the repairs involved bearing replacements. It is his opinion that it is not a good appliance and there is a fault in it. All of these dryers that have this same issue are Frigidaire Laundry Centers.

- The other venting that he has cleaned at the Blake Capital properties are at the South Shore Point property that he is responsible for. He cleans the vents at that location any time he repairs a dryer.
- He does not know if there are any screens at the exterior vent at The Ridges. He has been on the roof at that property, but he has never paid any attention to the vent.
- He has recently read an article about cleaning dryers in a newspaper. He believes it was not that long ago. It was in the Milwaukee Journal. There was an article about a house fire that talked about cleaning dryer vents.
- He could not say what maintenance conducted on the venting at The Ridges. He has never been personally involved in it or seen anyone conducting maintenance on the venting.
- Depending on where the collection boxes are located in the attic, some units may require additional horizontal runs of ridged piping, up to 15 feet. On the other hand, the vents located closer to the collection box, only have horizontal lengths of pipe of approximately 1 foot connecting the vertical risers to the box.
- He estimates that there could be up to a 25 foot horizontal run of ridged piping from the collection box to the exterior vent. Although this pipe is also ridged steel, it is not a 4" diameter vent like the others, it is a larger diameter.
- He has never cleaned the interior of the cabinet of a laundry center at The Ridges.
- He does not know if an outside vendor has ever been hired to clean the interior of her Laundry Center. He has never seen anyone there to conduct such maintenance.
- He cannot say whether or not the flexible dryer transition duct is replaced or cleaned prior to new tenants occupying The Ridges. He does not know if they are inspected for damage prior to a new tenant moving in. It is not his job to inspect them at that location.
- Depending on what is being replaced in the Laundry Centers, when he conducts repairs, he sometimes has to disassemble the dryers.
- He has not heard of any problems related to the subject laundry center in unit 115 occurring prior to the fire. He does not know if anyone else would be aware of any issues with that appliance.
- When presented with Exhibit 1, the customer instruction check list that would have come with the subject laundry center, he did not recall ever seeing that document.

- He believed The Ridges had long duct runs. To correct that and reduce the length to maximize efficiency they could have run the vent across the ceiling between the 1st and 2nd floor units to vent it outside. That would decrease the length and number of elbows needed. It was his opinion that this would probably provide a faster dryer time and better performance. He did not know if it would be a safety benefit.
- On the Frigidaire Laundry Center he repaired at the South Shore property, he could not see any warning labels on the exterior of the dryer. Presumably a tenant could not see them either.
- When presented with exhibit 4, the Owner's Guide, he has seen documents like this before. Those were the ones he has seen remaining in units after tenants move out. He has seen those in some of the units, but not all. He does not know if the property management at The Ridges instructs tenants to review this manual.
- It is his opinion that even if the property managers from Blake Capital recommended tenants review the Owner's Guide, it is unlikely the tenants would look at it anyway.
- Reading the Owner's Guide would allow someone to see what recommendations someone else may have, but he believed that common sense also goes a long way.
- He owns a dryer at home but he has never read his manual.
- Between his experience and common sense, he knows that the lint should always be cleaned out and that it should be operating property. When questioned what he meant by "cleaning out the lint", he stated that at home, he cleans the lint trap inside the dryer as well as the screen he has on the outside vent. His particular vent has a screen on it but not all exterior vents do. He also cleans the lint trap inside of the dryer every time they use it.
- His common sense also dictates that he does not over load his dryer.
- The only time he cleans his own dryer internally is when he has to repair it.
- When discussing the section of the Owner's guide about cleaning the interior of the dryer and exhaust vent every 18 months, Mr. Santos questioned the definition of cleaning and what the instructions meant by that. He questioned if that meant sending something physically up the vent pipe.
- He assumes that the other maintenance staff cleans the interior of the dryer anytime they may repair it, as that is his practice.

- He considers himself as "qualified service personnel". He believes a lot of his colleagues are also qualified.
- When asked how often the interior cleaning of the dryers would take place, he stated that it would be at the time of repair. It is not likely that these dryers would run for 4 or 5 years without the need for repair. These laundry centers seem to break down a lot.
- On the day of the fire, he was at unit 115 for approximately 5 minutes. Karen Starck had picked him up to go for a ride while he was on disability. Karen did not ask him to do anything at the time.
- When he walked through the unit, he had the opportunity to speak with the unit who lived in unit 115. The tenant informed him she had put clothes in the dryer and had left. He did not recall any other details. At that point he went back to the car to sit because he could not stand any longer.
- When he first observed the laundry center after the fire, it had been pulled out of the hallway and into the living room. He did not have an opportunity to inspect the rear of the laundry center.
- When shown a picture marked as exhibit 5, he opined that the flexible transition duct attached to the rear of the laundry center looked to be a flexible foil duct, not a flexible aluminum duct. Based upon the pictures, it is more likely foil than the heavier aluminum material.
- When shown exhibit 6, a picture of the laundry closet, the ridged venting depicted was not in its original position and a section of the wall had been ripped away.
- Based upon his recollection of the front of the laundry center on the day of the fire, he guessed that the fire had come out of the control panel of the dryer.
- From the conversation he had with the tenant, the dryer was in use at the time of the fire.

Subject Dryer Examination:

The exterior examination of the Laundry Center reveals localized oxidation and heat damage to the upper dryer portion of the appliance. The washing machine portion at the lower half of the appliance displayed no damage to the painted surfaces that would be consistent with a fire originating within the washing machine. Similarly, the interior of the washer tub was not

directly fire damaged and contained no load. Based upon these findings, a malfunction within the washing machine was eliminated as a potential fire cause.


Subject Laundry Center

The exterior of the dryer portion displayed fire patterns on the top, left and front sides. The dryer door had exterior fire patterns and the plastic door handle was missing. Fire patterns were concentrated to the left front corner of the cabinet, where the interior plastic components had been consumed. The rear of the dryer displayed soot damage where the edges of the cabinet and rear wall met. Both the louvered access panel and the cover for the power cord connection had been removed post-fire during the prior evidence examination. The front panel had also been removed previously and was held in place using duct tape at the time of this inspection.



Clothes Dryer Section

The 3 wire power cord was routed through the power cord opening and was equipped with a strain relief device. Localized fire damage was observed on insulation of the power cord where it entered the cabinet. The power cord connection cover was previously opened and the power cord was found properly wired to the appliance. There was no sign of electrical activity or overheating on the power cord or at the connection.



Power Cord

A portion of the venting had been included with the evidence. It consisted of a combination of flexible foil and rigid permanent ducting. Eighteen coils of flexible foil ducting were connected to the dryer. The flexible foil ducting was still clamped to the dryer at the time of this inspection. There were not any remains of lint in the flexible foil or the internal dryer duct. The permanent ducting consisted of approximately 4 feet of rigid metal duct, comprised of two straight sections and three 90 degree rigid metal elbows. When reconstructed in its original positioning, it totaled approximate 4 ½ feet in length. A very slight amount of lint was observed in the permanent ducting. The elbow that would have been positioned within the laundry closet closest to the vent connection at the rear of the appliance was equipped with a couple coils of wire from the flexible duct, connected via a band clamp. Charred lint was seen at the 90 degree elbow that was attached to the flexible foil duct. The venting was not arranged in the same form that the employees of Blake Capital recalled in their depositions, with rigid venting extending further down into the laundry closet than ceiling level. This indicated the permanent duct connection was at approximately the same height as the vent connection on the rear of the appliance. This allowed that the flexible foil was in its shortest length possible. The remainder of the permanently installed duct system in the attic was not collected or documented in any information provided to the Wright Group to date.

Venting Components

Examination of the drum opening and door of the dryer revealed both were directly fire damaged, with the concentration of fire patterns emanating from the area of the trap duct and blower housing at the left front corner. The interior of the door displayed heavy oxidation and the door gasket and label on the interior of the door had been entirely consumed. The door latch and door switch had both been heavily fire damaged, and the door latch was no longer securing the door. The lint trap and filter had been consumed. The dryer load, found previously secured in a plastic bag, was heavily fire damaged. The drum was rotated post fire and the visible load line had shifted.

Drum Opening

Interior of Door

Lint Trap

Dryer Load

The interior of the drum also displayed heavy fire damage and the drum paddles had been entirely consumed. Fire patterns observed in the drum were not consistent with the fire originating in the load, but rather that the drum was attacked by fire from the plastic blower assembly and trap duct below and to the left.

Interior of the Drum

Examination of the control console at the front of the appliance revealed that it was detached and burned from the inside outward. The fire damage was concentrated at the left side, from the former location of the trap duct and blower housing. The control knobs were missing from the switches. The timer shaft had broken in the fire and could not be tested to determine its setting at the time of the fire. The console was labeled with the Frigidaire Gallery name.

Control Console & Switch Positions

The control wiring displayed burned and consumed insulation throughout the controls. A loose wire had been previously secured and bagged with evidence with the control console. Electrical activity was observed on these wires.


Interior of Control Console


Control Console Electrical Activity

The front panel of the dryer was disassembled and the drum was removed allowing access to the interior of the dryer portion of the appliance. The interior of the front panel was examined. Heavy oxidization was observed to the interior side and the plastic trap duct and blower housing had been consumed.


Front Panel Removed

The drum was removed and the deflector attached to the rear of the drum contained no unburned or charred lint. Due to the extensive fire damage, it is likely that any lint that was accumulated on the rear of the drum and within the baffle had been consumed during the fire. Our testing and analysis of these Ball-Hitch dryer fires reveals that lint accumulates on the rear of the drum in every dryer, even those properly installed and operated under reasonably foreseeable conditions, with the amount dependent on individual variables. Examination of the baffle and rear of the drum revealed no evidence of electrical activity from contact with the heating element. The ball pivot was examined and was undamaged.

Lint on the Rear of the Drum

The interior of the dryer cabinet had sustained localized fire damage at and surrounding the blower housing at the left side, and fire damage to the rear wall and heater housing. The wiring harnesses and power cord connections observed inside of the dryer cabinet were consumed.

Electrical activity was observed on stranded conductors that had dropped to the dryer base at the motor location.

Interior of Dryer Cabinet

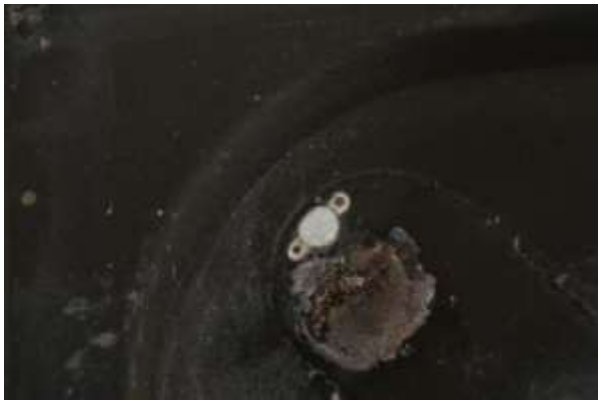
Wiring Harness

Examination of the dryer motor revealed that it had shifted from its original position within the dryer. The aluminum frame was melted and the motor windings had been damaged during the fire. The shaft was seized and could not be rotated. The centrifugal switch was intact and manually operated. No electrical activity was observed on the motor or the attached stranded copper conductors of the wiring harness. The motor and its associated wiring and components were eliminated as potential ignition sources.

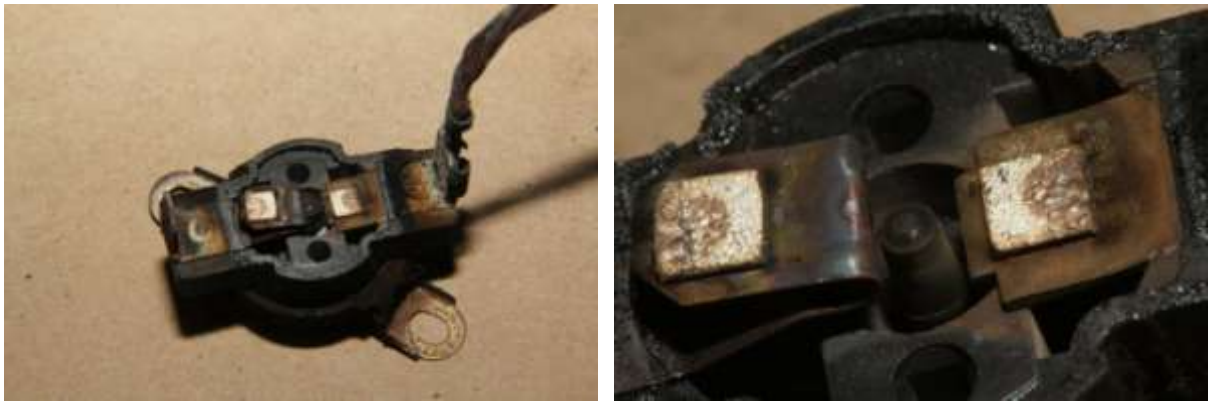
Motor

The plastic fan and blower housing had been completely consumed during the fire. The operational thermostat attached to the blower housing was destroyed during the fire and was not testable. Examination of the automatic re-settable and one-shot high limit safety switches revealed both were damaged by the fire. The one shot high limit safety switch had been removed post-fire. The automatic resettable high limit safety device was in place at the 11 o'clock position of the heater housing. The automatic resettable high limit safety device was not testable due to its post-fire condition. A visual inspection of its contacts was conducted. There was nothing to indicate the contacts had welded together, thus defeating the protection provided by this safety device. The contacts did display evidence of repeated cycling. Based upon the physical evidence it was determined that the automatic resettable high limit safety switch had operated repeatedly over the lifetime of dryer use due to elevated temperatures behind the drum from a reduction of airflow within the dryer. A cause of this would be related to reduced airflow within the dryer. Causes of reduced airflow include exhaust restrictions, inadequate make-up air, large loads and defective internal seals, and any combination thereof.


Operational Thermostat at Blower Housing




One Shot Safety

Automatic Resettable High Limit Safety Switch

Examination of the heater housing revealed normally mounted to the rear wall of the cabinet revealed that it had been removed during the prior evidence examination. The heater pan displayed evidence of heavy heat damage and oxidation. Examination of the heating element revealed the heating element was intact and showed no evidence of electrical activity. A resistance test was conducted on the coil and resulted in a reading of 11.8 ohms, which is a satisfactory resistance value for the heating element. All of the ceramic element standoffs used to secure the heating element in place and insulate it from the heater pan were in place. There was no evidence that the heating element had shorted to the heater housing or to the rear of the drum assembly. Any lint that may have been located in the heater pan was consumed during the fire.

Heater Housing

Conclusion from Subject Dryer Examination

Based upon this evidence examination, it is determined that the fire originated within the clothes dryer portion of this Frigidaire electric Laundry Center manufactured by Electrolux. No causes could be identified relating to any electrical or mechanical failures of the internal components. This fire was most probably caused by the ignition of lint by the heating element. The lint behind the drum was the first fuel and was ignited by the heating element. It is evident that burning lint embers were pulled through the drum and entered the trap duct where the lint accumulated there was ignited. The burning lint within the trap duct then spread fire to the plastic trap duct, blower housing and fan, which are constructed using the minimum allowable fire resistance rating allowed by the voluntary standards associated with these dryer. Ultimately, once the plastic internal components were ignited, the flames and products of combustion spread out of the dryer causing damage to the portion of the laundry room in which it was located. The ignition of the lint behind the drum was caused by the defective design of the dryer, which allows for lint to collect in proximity to the heating element behind the drum where it cannot be observed or removed by the user. The growth and spread of fire outside of the appliance was exacerbated by the improper selection of easily ignitable plastic components within the dryer.

Accumulation and Ignition of Lint in the Electrolux Dryer:

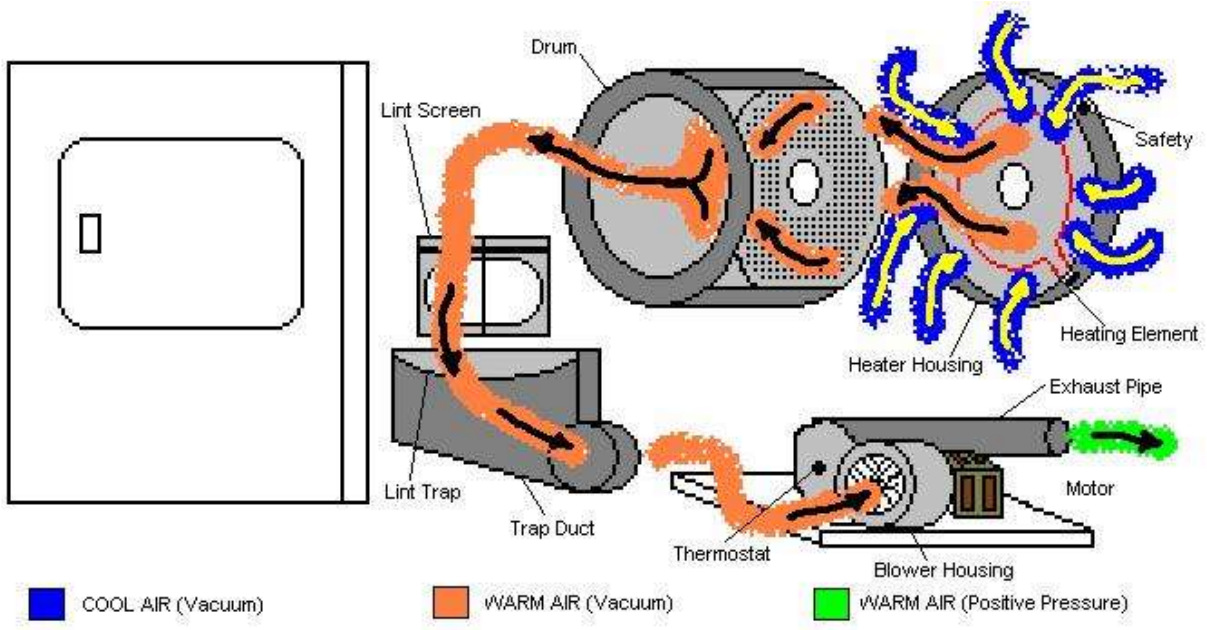
Generation and Adhesion of Lint

Clothing, towels, bedding and other products that are laundered are comprised of fabrics manufactured from a multitude of different materials including natural fibers, like cotton and wool, and synthetic fibers, such as polyester and nylon. Lint is made up of small portions of the fibers that are shed from these articles. The development of lint is an ongoing process that occurs over the lifetime of these fabrics. Movement of the woven materials results in breakdown of the fibers, releasing small portions of the fiber throughout the regular wearing or use of these articles and the laundering process. Beyond wearing, the washing process creates additional lint by compounding the breakdown of fabrics by minerals in the wash water, pH of the wash water, temperature of the wash water, chemicals in the detergents and/or liquid fabric softeners, chlorine bleach or other oxygenators if they are used, and lastly with the agitating motions of the washing machine itself. The breakdown of materials continues in the dryer with the addition of heat and further agitation of the fabrics against the interior of the drum and between the articles themselves. The lint that is generated throughout the wearing, washing and drying process becomes airborne in the dryer. The purpose of the lint screen is to capture as much lint particulate as possible, but the lint screen never captures 100% of the lint that is released from the clothing while in the dryer. The remaining lint is either accumulated within the dryer cabinet or is exhausted from the cabinet through the exhaust tube and attached external vent.

Airflow in the Subject Electrolux Dryer

Below is a simplified schematic of the airflows and the major component locations to assist in understanding the origin and cause of the present event. Note that ambient air enters the dryer cabinet and through the use of vacuum is pulled through the combustion chamber/burner assembly where it is heated, turns upward through the vertical heat duct and enters the heater housing/diffuser behind the drum. Air then enters the drum through the numerous holes located across the entire surface of the rear drum wall. The warm air then passes through the laundry load in the drum and flows through the lint trap, where the screen captures some of the airborne

lint particles, through the trap duct attached to the front panel and into the blower housing. The air that has been pulled through the dryer components at this point is pushed by the fan through the exhaust duct and out of the appliance into the external vent attached to the rear of the appliance.



Airflow Diagram – Electrolux Ball-Hitch Electric Dryer

Lint Accumulation in Exemplar Electrolux 5.7/5.8 Cu. Ft. Dryers

Wright Group, Inc. has been conducting extensive research into dryer fires over the past ten years. As part of our testing and analysis, the Wright Group has examined dryers from all major manufacturers. While many of the burned dryers have been examined as part of their relation to the cause of the fire, a number of unburned units that had never been reported to be involved in fires have also been examined. The appliances are most often obtained in used condition, to observe the after effects of real world usage. Due to the recent influx of dryers manufactured by Electrolux, we have obtained numerous exemplar dryers, both burned and unburned, to familiarize ourselves with the components, operation, design and maintenance of these units. Our analyses into fire cause and fire containment, has also led to baseline testing and fire testing of these appliances. A summary of our observations and data is outlined here for review.

It should be noted that the exemplar dryers obtained by the Wright Group, with the exception of some brand new dryers we have performed testing on, come from real world conditions or are dryers that have been involved in a fire or have been obtained used, as to demonstrate real life conditions. We consider every active and non-active dryer fire case an exemplar and use information and physical evidence from those other cases to support our findings, as firm evidence of the real conditions to which they are subjected. With some of these exemplars we have been able to document the exhaust system because the exhausts were collected as evidence. Others we have been able to obtain information about the exhaust from scene photographs or interview. Some dryers we have no understating of the operational history, installation or maintenance of the dryers. The same holds true with the majority of our unburned exemplar dryers, which we obtain through local retailers who remove used appliances when people purchase new ones. We rarely get a chance to remove appliances from a home environment, but rather receive them as recycled products. Others we obtain prior to them being reconditioned and re-introduced as used appliances. For those reasons it is impossible for us to document the information of how they were installed, how they were used and how they were maintained.

In examining the exemplar Electrolux dryers, we have noted that lint that is generated by washing and drying process is able to enter the space to the rear of the drum, regardless of the airflow traveling the opposite direction. The laundry in the drum contacts the perforated rear wall of the drum as it tumbles in the rotating drum. This results in stalled airflow, which allows the airborne lint particulate in the drum or any lint that is shed from the laundry contacting the rear perforations to penetrate through the rear of the drum. This happens constantly throughout the entire drying process.

Lint particulate also travels through the front of the drum into the components downstream, as outlined in the diagram above. The first and most obvious lint collection area is the lint filter screen at the lower front side of the drum opening in the front panel. This component is constructed of a plastic frame with a plastic, nylon or similar screen material. Downstream of the lint screen is the trap duct/blower housing assembly. All airflow within the dryer during operation is funneled through this choke point. The restriction, elbows and component materials cause a heavy accumulation of lint in this area. The trap duct is made of plastic and tapers to a

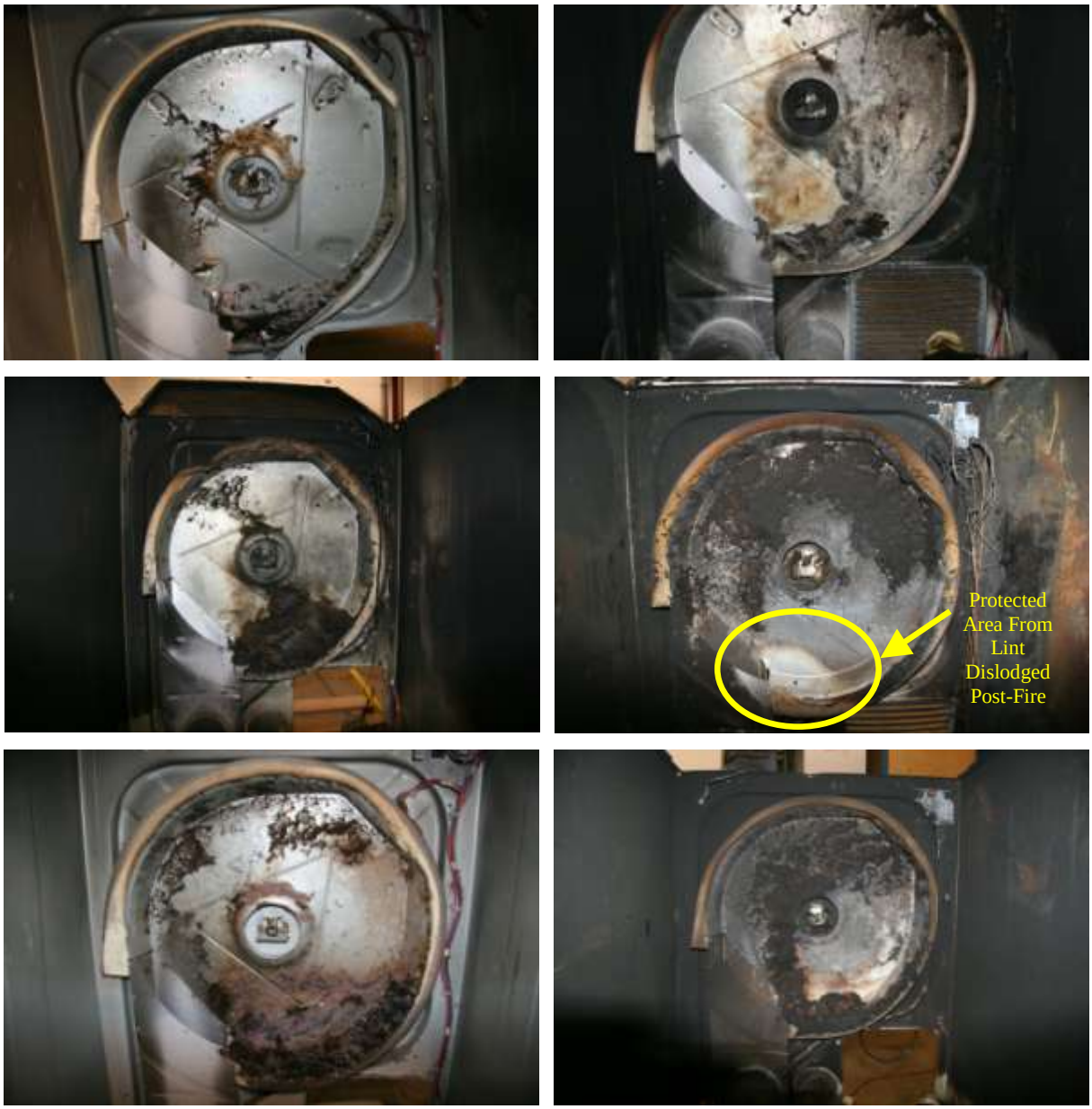
restrictive elbow at the lower corner of the front panel. The adhesive used at the factory to glue the trap duct to the front panel remains tacky during its lifetime and any lint introduced will bond to the adhesive in the trap duct area. It is connected via a foam gasket to the blower assembly, which is also made from plastic and houses the fan impeller. If improperly installed, the foam gasket that forms the seal between the trap duct and blower housing can result in reduced airflow.

Photos of Lint Accumulations in Exemplar Burned and Unburned Dryers
(At the Remains of the Trap Duct)

A significant quantity of lint collects within the heat diffuser (in gas dryers) or in the heater housing assembly (in electric dryers), which are located directly behind the drum. The gas dryer diffusers collect significantly more lint in this location than the electric, though both allow for lint to accumulate dangerously close to the heat source in either variation. Electric dryers have a deflector ring attached to the rear of the drum that collects lint and stores it against the rear of the drum, which is another significant lint collection location as it provides an opportunity for lint to

detach from the rear of the drum and fall onto the heating element. In addition, this quantity of lint is an excellent source of secondary spread fuels that is in very close proximity to the heating element located directly behind the drum. The gas-fired dryers are equipped with a felt seal that surrounds the diffuser and forms a seal between the diffuser and the rear of the drum. The purpose of the seal in the gas dryer is to force the air to be drawn through the burner tube so the gas flame can heat the air as it is drawn into the diffuser and then is directed into the drum. Due to this seal forming an enclosure between the diffuser and rear of the drum, there are no openings through which any lint can escape. For this reason it is common to see large quantities of lint accumulated in the lower portion of the heat diffuser, immediately adjacent to the vertical heat duct that carries the heated air from the gas burner in the base of the cabinet. Though there are differences in the mechanisms by which the lint collects in the area behind the drum between the gas and electric designs, both allow for collection of lint in close proximity to the heat source which provides a higher probability of a lint fire occurring than alternative designs used in the industry.

Photos of Lint Accumulations in an Exemplar Unburned Electric Dryer



Photos of Lint Accumulations in Exemplar Burned Gas Dryers

Lint also collects on the rear face of the drum. There are approximately 570 perforated holes on the rear wall of the drum that allow the air to be pulled from the heat diffuser to the rear into the laundry load within the drum. These holes are manufactured by punching through rear wall of the interior of the drum toward the rear. The result is smooth surfaces of each hole inside the drum, but a raised sharp surface on the rear wall of the drum, which further contributes to lint collection behind the drum. The shape and arrangement of these holes also allow lint to escape

from the interior of the drum and collect on the rear of the drum and inhibit the lint from being pulled back into the drum.

In addition, all electrical models and some of the recent gas models have a heat shield or baffle installed on the rear of the drum. In electric dryers, this heat shield was used to protect the clothes from obtaining direct exposure to the heating element. This is not necessary in the gas models so we believe it may have been installed in recent models to change the airflow characteristics at the rear of the drum. With this heat shield or baffle installed on the rear of the drum, an additional void space is created that allows for the additional collection of lint between the baffle and the rear face of the drum. In some ignition scenarios, particularly involving the electric dryers, this accumulated lint is the first fuel ignited. In cases where there is a significant quantity of lint accumulated on the rear of the drum, this lint also acts as a secondary fuel load that can assist in either spreading fire to the clothing inside the drum or lint accumulated further downstream in the trap duct.

Photos of Lint Accumulations at the Rear of the Drum (Gas & Electric Models)

Examinations of some of the used dryers manufactured by Electrolux, purchased strictly for use as exemplars to demonstrate internal lint accumulations, were found to have evidence of localized heating and/or charred lint behind the drum or small fires that were never discovered by the users. In addition, the burned dryers we have inspected as part of Origin & Cause investigations range from very minor damage to very major damage. These dryers have contributed to our understanding of lint accumulation, fire growth and development, fire containment and spread, potential ignition scenarios, etc.

In several minor dryers fires, damage was limited to the trap duct/blower housing and the lint that collected within this constricted assembly and was the result of lint ignited behind the drum being pulled into the lint trap and igniting the major accumulation of lint inside the trap duct. Numerous fire witnesses attest to only observing fire in the trap duct, not in the clothing load, before extinguishment of the fire. Since there is no ignition source in the trap duct, these fires

can only occur from the ignition of lint near the heat source, located behind the drum, and the transmission of that burning lint to the trap duct and lint accumulated in that location.

As an example, in one particular Origin & Cause investigation we performed, the user was drying a comforter in the dryer. When the cycle finished the user removed the comforter from the dryer, but did not fold the comforter or examine it. Approximately 15 minutes later, the user was alerted by a sounding smoke detector and after searching first observed flames limited to the trap duct area of the Electrolux dryer. During our scene examination, the comforter removed from the dryer prior to discovery of the fire was examined and had charred holes in a couple of places. This is clear evidence that the fire originated behind the drum in the heater housing from the ignition of lint that accumulated in that area. The burning lint was drawn into the load and into the trap duct, but only caused minor damage to the load before the user removed it from the drum after the cycle had finished. The delay in discovery was due to the smoldering fire in the trap duct that was not observed until after it had the opportunity to develop into a fire that ended up destroying the dryer and causing significant damage to the laundry closet, bathroom and hallway.

Electrolux's Contentions: Fires are caused by Misuse

Electrolux generally contends that its dryers are designed and manufactured in compliance with all applicable standards and, therefore, and fires that result in their dryers are caused by factors beyond their control. Electrolux categorizes only three causes of dryer fires involving their products: "improper installation", "misuse of the dryer" and "lack of maintenance". It is their contention that their product is properly designed and manufactured and any fires that occur once the unit leaves their control is not their fault. This is regardless if the fire was caused by the ignition of lint accumulated near the heat source or, in electric dryers, caused by an arcing event at the heating element caused by a failed drum bearing or foreign object escaping the drum and contacting the heating element. When confronted with lint ignition as the cause, Electrolux typically maintains that the accumulation of lint near the heat source is the fault of the user for failing to properly install or maintain the dryer. When confronted with fires caused by bearing failures, Electrolux typically maintains that the user is at fault for failing to recognize any

potentially occurring abnormal squeaking or squealing as a precursor to a dangerous fire condition. And when confronted with a fire caused by a foreign object from the load contacting the heating element, Electrolux will argue that it was misuse that placed the foreign object in the drum, even though it is foreseeable the user may overlook a small item such as a bobby pin making its way into the laundry load. Electrolux further contends that none of these potential failures and hazards warrants any changes to the subject design of dryer.

Airflow: Restrictions and Leaks

Any restrictions or air leakage will affect the airflow within the dryer, and a change in the airflow will affect the efficiency of the lint particulate ejection. While exhaust restrictions are one of the factors commonly blamed for the collection of lint inside the dryer, it is not the restricted exhaust alone that is the sole factor on how much lint will accumulate in a dryer. The total amount of lint shed from the dryer loads is based on many other factors, including the type and condition of the clothing loads, the way and under what conditions in which they are washed, the period of time each dryer cycles last, the number of cycles the dryer is run, etc. Restrictions or air leakage causes increased drying times, one of the major reasons for lint to accumulate within the dryer. The increased drying times allows for more lint shedding from the clothing materials, as well as more lint generation for the tumbling action in the dryer drum. The longer the clothes tumble and chafe against each other or against the interior of the drum, the more lint is released into the dryer. Those same restrictions or air leakage then allow the extra lint that is released because of extended drying times to collect within the cabinet because of the reasons listed above, such as decreased air velocity, gaps in the drum seal, etc.

Minor restrictions or air leakage of any kind will affect the “vacuum” in the void space between the heat diffuser pan/heater housing and rear of the drum. This will allow for lint particulate to not be totally exhausted from the drum and accumulate instead behind the drum, as observed during the examination of exemplar dryers. This area to the rear of the drum is the most critical when referring to the potential for the ignition of lint, as it is where the heat sources for Electrolux dryers are located and the collection of a lightweight, easily ignitable first fuel collected near a competent heat source becomes inherently hazardous. Any type of minor

restriction or air leakage will also affect the "vacuum" in the bottleneck and elbow formed where the trap duct (below the lint screen) mates to the front face of the blower fan housing. This fan is the transition point between negative pressure (or vacuum) and positive pressure (forced ventilation). The lint will accumulate in this area, as observed in the numerous examinations of exemplar dryers where lint was observed in the plastic trap duct.

Numerous factors can promote the adhesion of lint particles to the internal surfaces within the dryer cabinet. These factors generally include the smoothness of the surfaces of the components, the moisture content and/or density of the lint particles, condensation, gravity, static electricity, air leaks, bends, restrictions and blockages. This is not limited to dryers, but also would include any airborne particulate handling equipment, such as HVAC systems, etc. Any hypothesis that a restriction or blockage of the exhaust due to improper installation or maintenance being the sole cause of lint accumulation within the dryer places undue emphasis on a portion of the factors that lead to the accumulation of lint.

Reductions in airflow are created in several ways. One way to create an airflow reduction is to reduce the diameter of the exhaust vent to reduce output airflow. The addition of bends or increasing the length of the vent also reduces output airflow downstream of the blower fan. Reducing the amount of intake air will also reduce airflow throughout both the negative and positive pressure sides of the blower fan. Introducing foreign objects into the path of airflow will also reduce airflow on the whole. Lint accumulations in the dryer ventilation components and in the external exhaust ducting will reduce airflow and cause faster accumulation of lint within the cabinet of the dryer. But conversely, restrictions in the dryer itself are inherent to the design and vary depending on the load. A load that sheds a heavier quantity of lint based upon its size, material, etc., will restrict airflow through the lint screen, when compared to a load that does not generate as large a quantity of lint. Similarly, the introduction of a large laundry load into the drum (i.e. a comforter or other large items) also causes a restriction, and thus changes the airflow characteristics and efficiency of lint ejection. These are both restrictions that vary greatly from dryer to dryer, depending on the laundry applications each particular dryer is subjected to.

Air leakage is another major factor in the accumulation of lint within the dryer cabinet. The path of airflow is meant to carry the heated air into the tumbling laundry load and then exhaust the moisture laden air, and any lint that may not have been captured by the lint screen, into the exhaust ductwork and ultimately to the exterior of the structure. Any openings, gaps or improper seals allow air leakage that reduces airflow throughout the dryer, which contributes to the collection of lint behind the drum in the subject Electrolux dryers.

In the subject Electrolux dryers, key places where air leakage occurs includes:

1. The interface between the front of the drum and the front panel, sealed by a combination of plastic glides and felt gasket material.
2. The interface between the lint trap, trap duct and front panel.
3. The junction between the blower housing and trap duct, sealed by a piece of foam sandwiched between these two components.
4. The junction between the internal exhaust pipe and blower housing, sealed by a wide rubber band surrounding this interface.

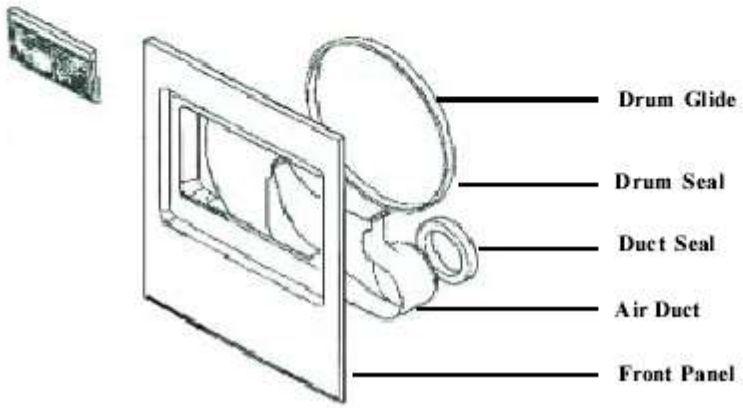
All of these interfaces are downstream of where the warm air enters the drum and the lint particulate is released from the clothing and becomes airborne. Electrolux has produced Technical Service Bulletins that demonstrate they are aware that air leakage has occurred over a number of years in the subject dryer design and uses those bulletins to attempt to correct problems they have with their dryer design.

Electrolux's Technical Service Bulletins: Reduced Airflow Causes

Electrolux has released a service bulletin in November 2000 (**Attached as Appendix II**) to educate the service providers in regards to ineffective drying and causes related to air leakage at various components of the Electrolux dryers. Below are excerpts from the service bulletin with highlighted areas of interest:

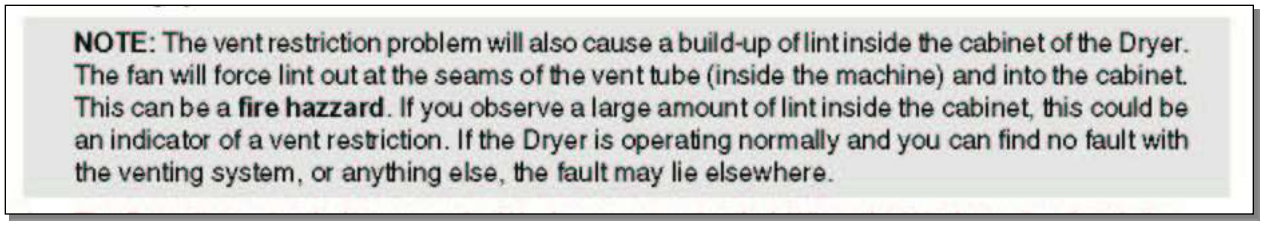
2. If it is an Electric Dryer, check to see that full power is available at the receptacle. The motor will run and the drum will tumble if supplied with 110 volts (or 108V or 120V), but the heater requires 220 volts (or 215V or 240V). If it is not heating, find out why. If it is a Gas Dryer, is the burner igniting? Once ignited, does it continue to burn or does it immediately shut down? With the door shut you can hear the burner ignite and then cycle off. Bear in mind that if the door is open it will cycle on the flame switch at a much faster rate than normal. The blower will pull air from the path of least resistance, namely the open door and not through the burner tube. This will cause heat to pool in the burner area instead of being drawn through the drum, which then causes the (bimetal) limit switch to open, thus cutting power to the coils in the valve and turning off the gas.

In either model, this "short-cycling" can also be caused by a defective seal on the door, an improper seal at the drum glide or drum seal, or the air duct seal between the fan cover located on the fan housing and the duct that is mounted on the front panel (see illustration), as well as a defective blower fan. The result is that the load will take longer to dry.



Electrolux Service Bulletin – November 2000, Page 16

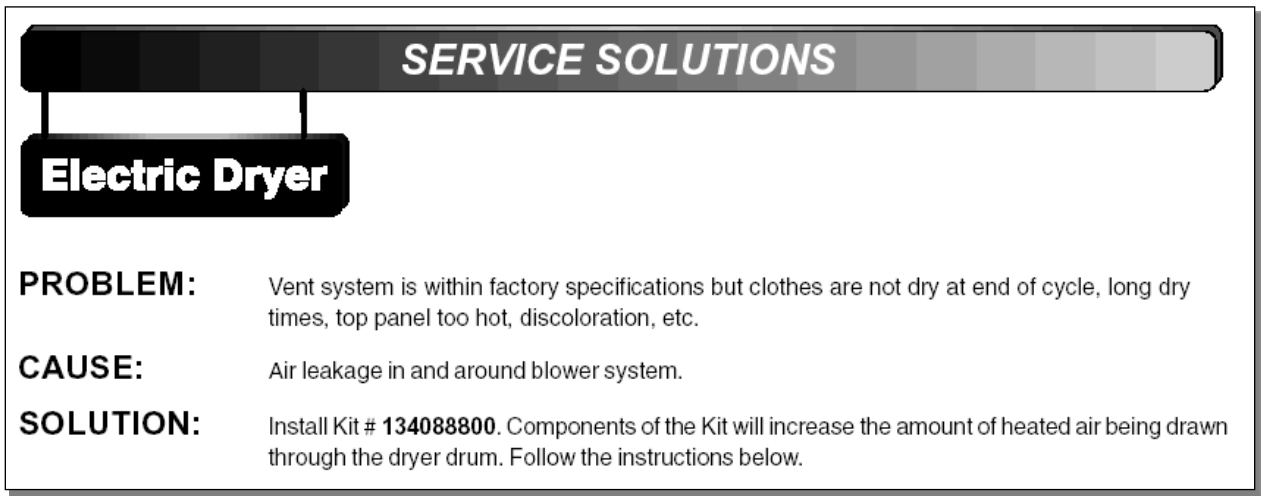
The statement highlighted above expresses that Electrolux is aware that "short cycling" means that the dryer is operating off of its high temperature limiting safety device as opposed to its operational thermostat. This "short cycling" is manifested by extended drying times. The service bulletin goes on to describe four potential defects of the dryer components that should be assessed by the technician when diagnosing the cause of the extended drying times, including leaks at the door seal, drum glide or seal, seal between the trap duct and blower housing or a defective blower assembly. These defects are directly related to internal components and are independent of installation or maintenance issues that Electrolux typically blames as the only potential causes for reduced airflow within the dryer. And in the statement below, Electrolux warns servicers that vent restrictions are not the sole cause for large amounts of lint observed in the cabinet.



NOTE: The vent restriction problem will also cause a build-up of lint inside the cabinet of the Dryer. The fan will force lint out at the seams of the vent tube (inside the machine) and into the cabinet. This can be a **fire hazzard**. If you observe a large amount of lint inside the cabinet, this could be an indicator of a vent restriction. If the Dryer is operating normally and you can find no fault with the venting system, or anything else, the fault may lie elsewhere.

Electrolux Service Bulletin – November 2000, Page 17

Electrolux released a service bulletin in July 2001 that further addressed air leakage in and around the blower system that resulted in customer complaints of extended drying times. The fix moved the heater pan forward, added clips to better seal the trap duct to the front panel, and new gasket and adhesive materials to replace the seal between the trap duct and blower housing.



SERVICE SOLUTIONS

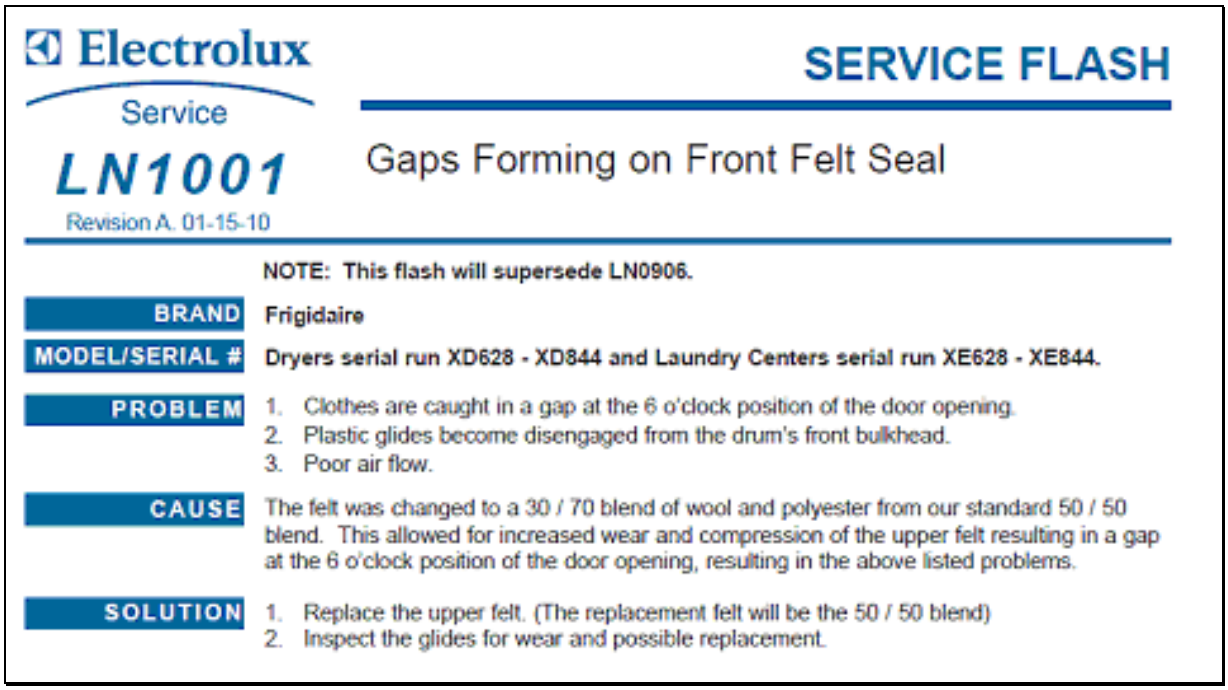
Electric Dryer

PROBLEM:	Vent system is within factory specifications but clothes are not dry at end of cycle, long dry times, top panel too hot, discoloration, etc.
CAUSE:	Air leakage in and around blower system.
SOLUTION:	Install Kit # **134088800**. Components of the Kit will increase the amount of heated air being drawn through the dryer drum. Follow the instructions below.

Electrolux Service Bulletin – July 2001, Page 6

Electrolux has released service bulletins dating back to 2000 to alert the service providers to the fact that the front drum seal is deficient and can result in poor airflow, items being caught in the gap and the drum glides detaching. These bulletins are also included in **Appendix II.** In the November/December 2001 – Issue #11 Service Bulletin, the original front drum glides/seal was modified to "Improve the sound quality of the dryer". In the April 2003 – Issue #3 Service Bulletin, the felt seal was to be turned around to correct the problem of "Too large a gap between the felt and drum glide". In the December 2004 – Issue #9 Service Bulletin, the felt seal was replaced with a "new, thicker felt" to correct "the upper felt may compress causing a gap between the lower felt and drum glide". Below is the latest excerpt from the most recent Service

Flash, LN1001 from January, 2010 regarding "poor airflow" resulting from a change in the felt seal that resulted in gaps forming at the drum seal. It should be noted that the serial numbers listed were produced from 2006 to 2008.



Electrolux
Service

LN1001
Revision A. 01-15-10

SERVICE FLASH

Gaps Forming on Front Felt Seal

NOTE: This flash will supersede LN0906.

BRAND	**Frigidaire**
MODEL/SERIAL #	**Dryers serial run XD628 - XD844 and Laundry Centers serial run XE628 - XE844.**
PROBLEM	1. Clothes are caught in a gap at the 6 o'clock position of the door opening. 2. Plastic glides become disengaged from the drum's front bulkhead. 3. Poor air flow.
CAUSE	The felt was changed to a 30 / 70 blend of wool and polyester from our standard 50 / 50 blend. This allowed for increased wear and compression of the upper felt resulting in a gap at the 6 o'clock position of the door opening, resulting in the above listed problems.
SOLUTION	1. Replace the upper felt. (The replacement felt will be the 50 / 50 blend) 2. Inspect the glides for wear and possible replacement.

Example Service Bulletin from Electrolux on January 15, 2010

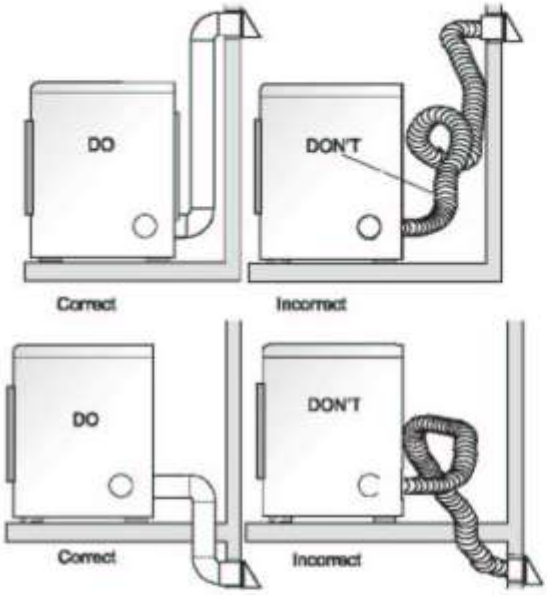
External Exhaust Components

Electrolux will often cite deficiencies in the exhaust systems, such as non-compliance with manufacturer's instructions regarding the length of duct or type of materials used. Electrolux will make these contentions regardless of the actual venting efficiency of the exhaust ducting as it was installed. For example, a dryer vented using an eight foot single section of flexible foil transition duct connected to an exterior vent hood would be against manufacturer's instructions even if the duct is fully expanded, contained no kinks, and provided greater venting efficiency than the maximum allowable installation of 44 feet of rigid metal duct with two 90° elbows.

In their Installation Instructions, Electrolux "recommends" the method of installation using a table as a guide. The table allows for a certain length of duct and number of elbows, depending on the type of hood used and material that the duct is constructed of. On this same page of the

Installation Instructions, Electrolux recognizes that installations can be different. They provide additional instructions that the exhaust system is acceptable so long as the backpressure is no greater than 0.75 inches of water column. The Wright Group has conducted testing on numerous different configurations of exhaust installations and found that the "recommended" setup according to the chart does not come close to the maximum allowable backpressure. One of our tests used a configuration of 72 feet of duct with eight 90° elbows and only reached 0.70 inches of water column backpressure. The Wright Group's testing proved that even if the dryer is vented using a flexible duct installed in the correct manner, it will not cause a greater amount of measured back pressure in the form of an exhaust restriction than one vented with the use of rigid or semi-rigid duct.

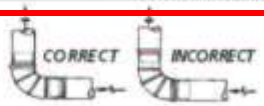
An example of the Installation Instructions with highlighted is included below:



WARNING ***Explosion hazard. Do not install the dryer where gasoline or other flammables are kept or stored.*** If the dryer is installed in a garage, it must be a minimum of 18 inches (45.7 cm) above the floor. Failure to do so can result in death, explosion, fire or burns.

Number of 90° Turns	MAXIMUM LENGTH of 4" (10.2 cm) Dia. Rigid Metal Duct — VENT HOOD TYPE (Preferred)	Louvered	
	4" (10.2 cm)		2½" (6.35 cm)
0	60 ft. (18.28 m)		48 ft. (14.63 m)
1	52 ft. (15.84 m)		40 ft. (12.19 m)
2	44 ft. (13.41 m)		32 ft. (9.75 m)
3	32 ft. (9.75 m)		24 ft. (7.31 m)
4	28 ft. (8.53 m)		16 ft. (4.87 m)

Number of 90° Turns	MAXIMUM LENGTH of 4" (10.2 cm) Dia. Flexible Metal Duct — VENT HOOD TYPE (Preferred)	Louvered	
	4" (10.2 cm)		2½" (6.35 cm)
0	30 ft. (9.14 m)		18 ft. (5.49 m)
1	22 ft. (6.71 m)		14 ft. (4.27 m)
2	14 ft. (4.27 m)		10 ft. (3.05 m)
3	NOT RECOMMENDED		



INSTALL MALE FITTINGS IN CORRECT DIRECTION

CAUTION ***- Risk of Fire - A clothes dryer must be exhausted outdoors*** Do not exhaust dryer into a chimney, a wall, a ceiling, an attic, a crawl space or any concealed space of a building. A clothes dryer produces combustible lint. If the dryer is not exhausted outdoors, some fine lint will be expelled into the laundry area. An accumulation of lint in any area of the home can create a health and fire hazard. ***The dryer must be connected to an exhaust outdoors.*** Regularly inspect the outdoor exhaust opening and remove any accumulation of lint around the outdoor exhaust opening and in the surrounding area.

WARNING ***Do not allow combustible materials (for example: clothing, draperies/curtains, paper) to come in contact with exhaust system.*** The dryer ***MUST NOT*** be exhausted into a chimney, a wall, a ceiling, or any concealed space of a building which can accumulate lint, resulting in a fire hazard.

WARNING ***Exceeding the length of duct pipe or number of elbows allowed in the "MAXIMUM LENGTH" charts*** can cause an accumulation of lint in the exhaust system. Plugging the system could create a fire hazard, as well as increase drying times.

WARNING ***Do not screen the exhaust ends of the vent system, nor use any screws, rivets or other fastening means that extend into the duct and catch lint to assemble the exhaust system.*** Lint can become caught in the screen, on the screws or rivets, clogging the duct work and creating a fire hazard as well as increasing drying times. Use an approved vent hood to terminate the duct outdoors, and seal all joints with duct tape. All male duct pipe fittings ***MUST*** be installed downstream with the flow of air.

In installations where the exhaust system is not described in the charts, the following method must be used to determine if the exhaust system is acceptable:

1. Connect an inclined or digital manometer between the dryer and the point the exhaust connects to the dryer.
2. Set the dryer timer and temperature to air fluff (cool down) and start the dryer.
3. Read the measurement on the manometer.
4. The system back pressure ***MUST NOT*** be higher than 0.75 inches of water column. If the system back pressure is less than 0.75 inches of water column, the system is acceptable. If the manometer reading is higher than 0.75 inches of water column, the system is too restrictive and the installation is unacceptable.

Although vertical orientation of the exhaust system is acceptable, certain extenuating circumstances could affect the performance of the dryer.

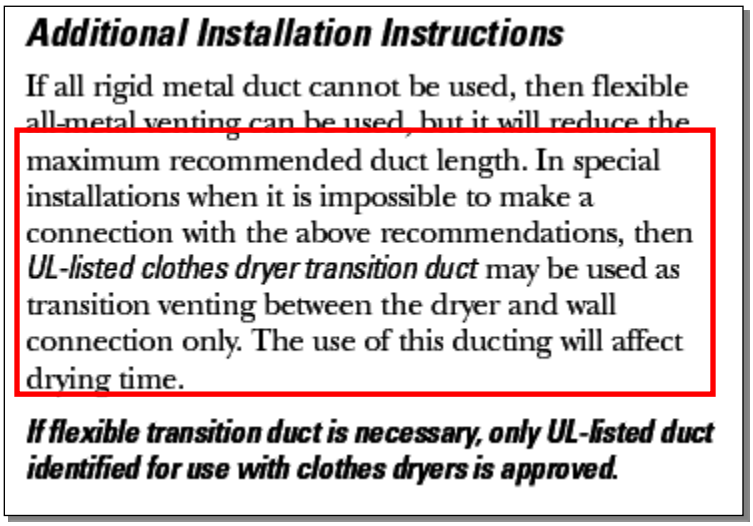
- Only the rigid metal duct work should be used.

4

Installation Instructions

GE Version of Warnings & Instructions

Electrolux has double standards when it comes to exhaust recommendations. Electrolux dryers sold under their own Frigidaire brand name have identical exhaust characteristics as the dryers they make for General Electric, but each brand has a differing set of instructions as to the type of vent materials allowed. Some General Electric User Guides produced by Electrolux expressly allows for the use of flexible foil transition ducts, while the Frigidaire manuals for the same basic dryer recommend against the use of flexible foil transition ducts.



Additional Installation Instructions

If all rigid metal duct cannot be used, then flexible all-metal venting can be used, but it will reduce the maximum recommended duct length. In special installations when it is impossible to make a connection with the above recommendations, then *UL-listed clothes dryer transition duct* may be used as transition venting between the dryer and wall connection only. The use of this ducting will affect drying time.

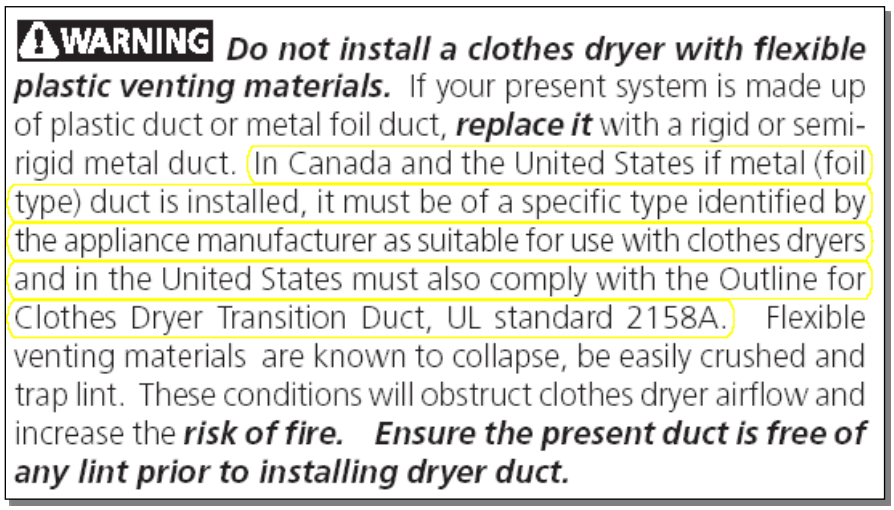
If flexible transition duct is necessary, only UL-listed duct identified for use with clothes dryers is approved.

Excerpt From GE Dryer Owners Guide & Installation Instructions

Recent Variations of Installation Instructions Allowing for Flexible Foil Ducts

Newer variations of the Electrolux manuals for their clothes dryers contains allowances for the use of flexible foil transition ducts that are approved under UL 2158A, the Standard for Clothes Dryer Transition Ducts. These allowances appear in Installation Instructions for numerous dryer model lines since approximately 2008, including those in the Affinity line. The Affinity line was at one time comprised of both the subject ball-hitch design, which has now been discontinued in favor of the preferable bulkhead design. But regardless of the design type, the installation

instructions for all of these dryers manufactured by Electrolux specifically allow for the use of a flexible foil duct, as evident from the following excerpt from the Installation Instructions.



WARNING ***Do not install a clothes dryer with flexible plastic venting materials.*** If your present system is made up of plastic duct or metal foil duct, ***replace it*** with a rigid or semi-rigid metal duct. In Canada and the United States if metal (foil type) duct is installed, it must be of a specific type identified by the appliance manufacturer as suitable for use with clothes dryers and in the United States must also comply with the Outline for Clothes Dryer Transition Duct, UL standard 2158A. Flexible venting materials are known to collapse, be easily crushed and trap lint. These conditions will obstruct clothes dryer airflow and increase the ***risk of fire.*** ***Ensure the present duct is free of any lint prior to installing dryer duct.***

Excerpt From Frigidaire Installation Instructions,
Model GLGQ2152EE1, Doc. Date: 04/08

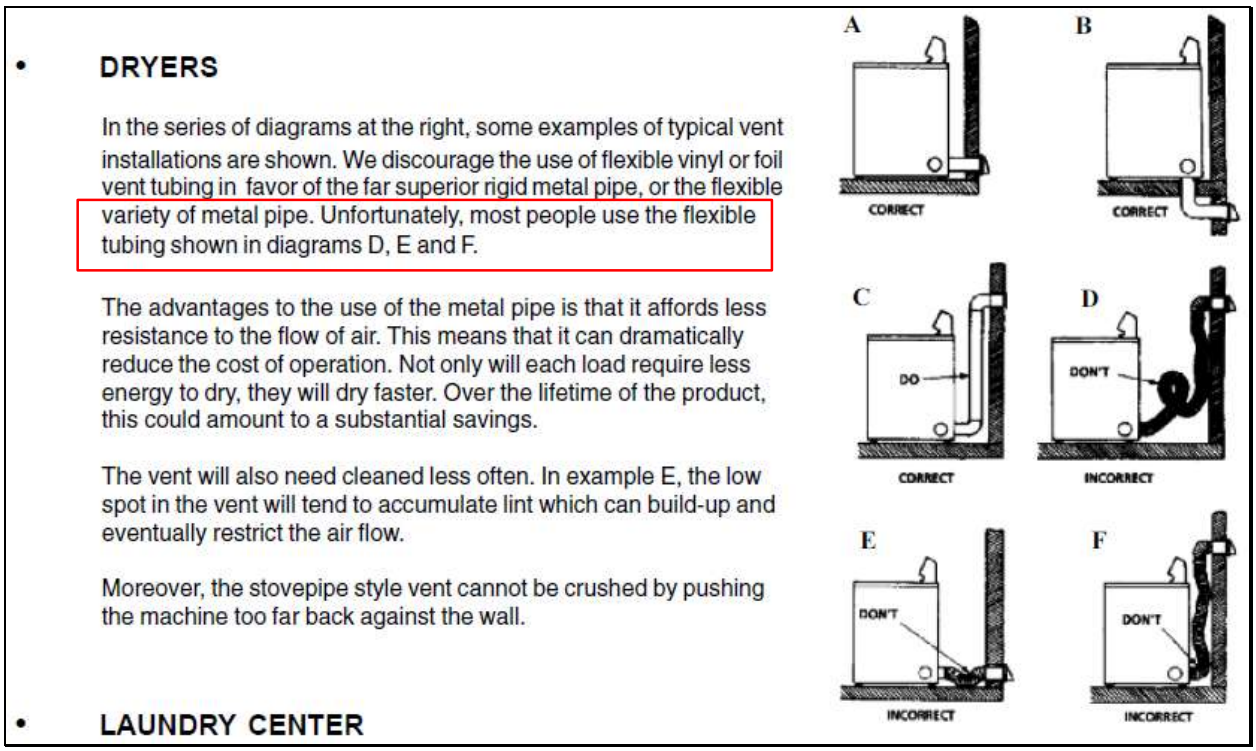
Electrolux Distributes Flexible Foil Dryer Vents

More notably, Electrolux itself has marketed and distribute these same flexible foil transition ducts that they prohibit the use of, under the Electrolux name. An exemplar of this duct was purchased at the same store where their dryers are sold. The packaging of the Electrolux brand flexible foil duct states that it is "universal" and "fits most brands". There is no instruction not to use flexible foil vent with any of the dryer brands manufactured by Electrolux, such as the subject dryer. The Electrolux packaging further states "UL listed clothes dryer transition duct gives you the assurance of Underwriters Laboratories, Inc."

Flexible Foil Transition Ducts Distributed by Electrolux

Electrolux Acknowledges Prevalent Use of Flexible Foil Ducts

Electrolux has issued multiple service bulletins, including one in November of 2000 **(See Appendix II)** stating, "We discourage the use of flexible vinyl or foil vent tubing in favor of the far superior rigid metal pipe, or the flexible variety of metal pipe. Unfortunately, most people use the flexible tubing shown in diagrams D, E and F." This indicates that Electrolux has been aware of the fact that it is foreseeable that most of their dryers will be installed using flexible exhaust ducts, notwithstanding recommendations to the contrary in the installation instructions.



- **DRYERS**

In the series of diagrams at the right, some examples of typical vent installations are shown. We discourage the use of flexible vinyl or foil vent tubing in favor of the far superior rigid metal pipe, or the flexible variety of metal pipe. Unfortunately, most people use the flexible tubing shown in diagrams D, E and F.

The advantages to the use of the metal pipe is that it affords less resistance to the flow of air. This means that it can dramatically reduce the cost of operation. Not only will each load require less energy to dry, they will dry faster. Over the lifetime of the product, this could amount to a substantial savings.

The vent will also need cleaned less often. In example E, the low spot in the vent will tend to accumulate lint which can build-up and eventually restrict the air flow.

Moreover, the stovepipe style vent cannot be crushed by pushing the machine too far back against the wall.

- **LAUNDRY CENTER**

Example Electrolux Service Bulletin from November 2000

Flexible foil transition ducts that meet the minimum standards of UL 2158A, for Clothes Dryer Transition Ducts, are readily purchased at appliance dealerships across the United States. These flexible ducts are used not only by homeowners, but also by appliance delivery and service people that install dryers on behalf of those homeowners who do not install the dryers themselves. In paying for the additional service to have their dryer delivered and installed at their home, homeowners would expect that the installer would use a safe and appropriate external vent when installing the dryer. In most cases, the professional installer is apt to ignore the recommendations in the installation instructions and use a flexible vent, such as the one the Electrolux itself has marketed.

Temperature Limiting Safety Devices

Changes in airflow from restrictions and air leakage not only affect the efficiency of ventilation, but also alter the performance characteristics of the appliance. This is a result of a significant reduction of airflow behind the drum that causes increased temperatures in the heater pan. As a result of decreased airflow in that location, the high limit safety device (located at the one

o'clock position of the heater housing or diffuser pan in an Electrolux dryer) will be heated and will open a set of energized contacts. When this occurs, the bi-metallic disk pushes against a pin, which separates the moveable contact from the fixed contact. As the contacts separate, a "parting arc" is formed until the contacts separate far enough to interrupt the arc. The result of the contact separating is that power is disrupted to the heat source, and the flame is extinguished or heating element de-energized. The dryer fan remains running, removing the heated air and allowing the high limit safety switch to reset once the bi-metallic disk cools and the moveable contact returns to its normally closed position against the fixed contact. If the cause of the insufficient airflow is not corrected the clothes dryer will continue to operate, however, the dryer will be effectively controlled by its high limit safety device instead of the operational thermostat, which will not operate due to the lower temperatures at that location. The result will be that the burner will continue to cycle ON and OFF, but the ON cycle will be reduced, because the heat produced will not be vented from the appliance as designed.

Physical evidence of this condition can be found by a visual examination of the contact surfaces of the high limit safety device. The previously described parting arc creates temperatures of thousands of degrees or more. When this occurs, the surface of the contact is melted. As repetition of the parting arc occurs, the surface is melted again and again. Byproducts of the arc include vaporization of the metal contact material, which is observed in the form of a blackened or discolored area at the center of the contact, followed by pitting and eventually deformation of the contact surfaces as repeated cycling occurs. By examining the contacts, one can determine if the dryer had a reduced airflow condition that caused the high limit safety device to activate, and also can gauge the number of times this safety device cycled.

Un-Cycled Contact

Heavily Cycled Contact

DESIGN ANALYSIS AND DESIGN ALTERNATIVES:

It is our opinion that the subject Electrolux dryer is defective in its design. Through the use of principles accepted in engineering, design and manufacturing communities, Basic Safety Engineering principals should have been employed during the design of the subject dryer. Failure Mode and Effect Analysis, another principal shared between design/manufacturing and fire investigation communities was used to not only evaluate the cause of the fire as listed above, but also to analyze the subject design as it relates to hazards and propose alternative designs to improve the safety of the appliance without removing the functionality or decreasing efficiency. The Wright Group began by analyzing the three most common dryer designs, comparing differences in those designs and determining if the subject Electrolux dryer could have been designed to reduce or eliminate the various potential failure modes and their associated fire hazards.

Basic Concepts of Safety Engineering

It is the duty of the manufacturer of every product available to the general public to make sure it is not only constructed to the required standards, but is also designed and manufactured in ways that make the product safe to the end user. Safety Engineering is a term used to describe the basic principles behind the design of a product and is subject to re-evaluation throughout the production life of that product. These basic principles are as follows:

1. **Identify the Hazards:** All available background information regarding the proposed design should be collected, reviewed and analyzed. Important background information would include, for example, the foreseeable use and misuse of the product, the environment in which the product is expected to be used and the capabilities and behaviors of the users. While the review of codes and standards are also important, they generally have serious limitations that the designer needs to be aware of. For instance, a standard cannot address every possible design situation that may be encountered, or the

standard writing process (negotiation and compromise) can severely weaken the safety content of a standard.

Many hazards can be readily identified, such as those that create cutting, pinching or crushing hazards. Obviously, any components that generate heat should be evaluated as to the risk of fire and burn hazards. But there are also hidden hazards that need to be accounted for during the safety evaluation process. A common approach is the "what if" analysis, utilizing a series of questions focusing on each component's manufacturing processes, materials, maintenance, wear and tear, operator error, operator capabilities, etc. The types of questions that should be posed in the "what if" analysis might include: "What if the component does not operate as intended?" or "What if the user forgets to perform routine maintenance?"

2. **Eliminate or Reduce the Risk to an Acceptable Level:** Once all the hazards have been identified, the first priority is to eliminate or reduce the risk to an acceptable level. There are two ways to accomplish this. The first is to design the hazard out of the system. An example would be using a ramp instead of steps to eliminate a trip hazard. If a design alternative doesn't eliminate the hazard or provide adequate risk reduction, then an engineered guard or safety device should be considered as the secondary alternative. An example of a guard would be a blade guard on a table saw that reduces the risk to the operator from injuring themselves by inadvertently contacting the rotating saw blade. An example of a safety device would be a tip switch on a portable electric heater that eliminates the possibility of a fire occurring if the operating heater falls over onto combustible materials.

3. **Provide Adequate Warning and/or Written Instruction:** In some cases it is not possible to achieve adequate risk reduction by a design change or by providing suitable engineered guards or safety devices. Only after exhausting those avenues is it appropriate to rely on the use of warnings and or written instructions. A warning can be either active, in the form of a visual indicator or audible alarm, or passive, in the case of warning labels. A warning label or sign should alert the user to the specific hazard, the

seriousness of the hazard, the consequences of interaction with the hazard and the ways to avoid the hazard. ANSI standard Z535 covers the required details of the warning label, such as size, color, placement, wording, etc. A warning should never be used in place of an alternative design or an engineered guard or safety device.

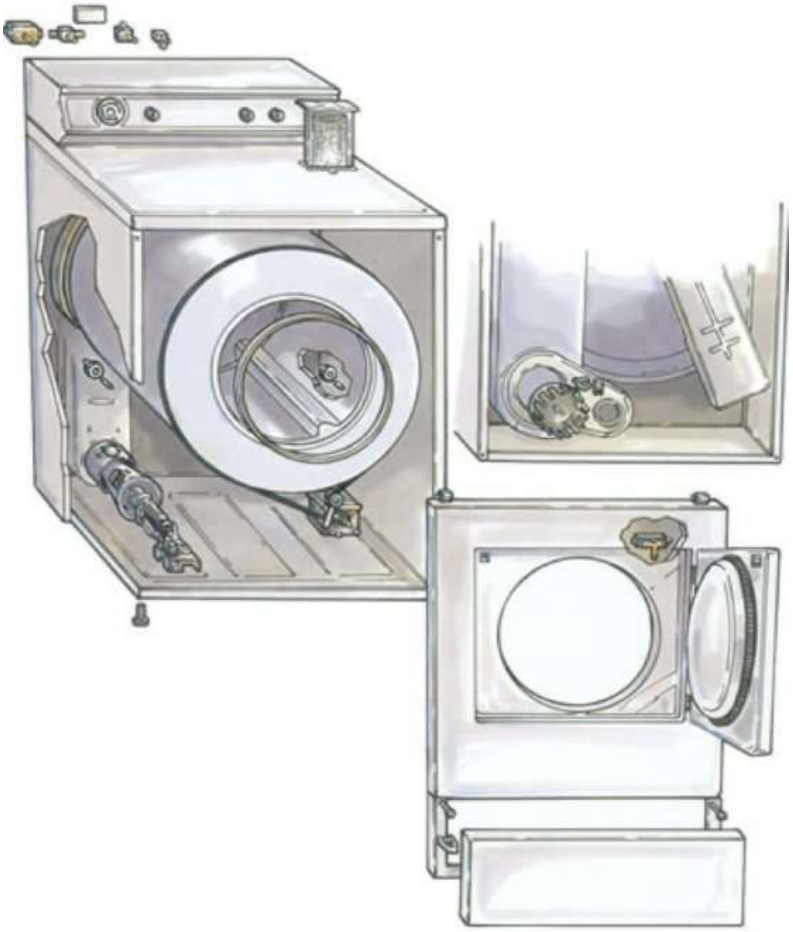
Comparison of Various Dryer Designs:

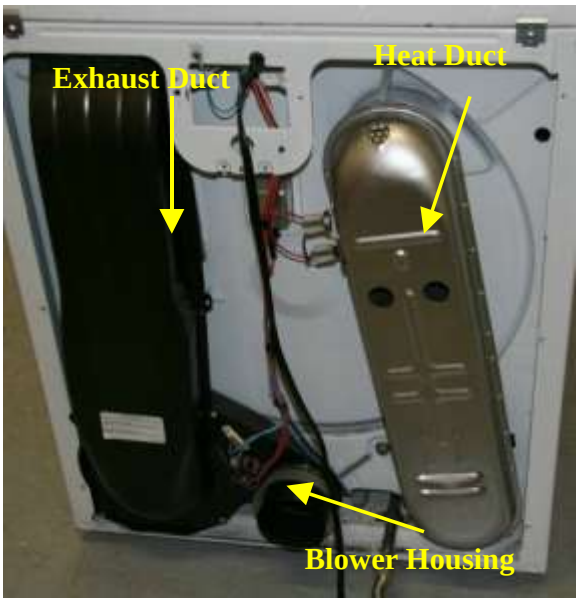
All clothes dryers contain inherent heat sources to produce the warm air needed to dry the wet clothing, either in the form of gas burners or electric resistive heating coils. They all contain motors, both to rotate the drum, to draw air over the heat source using negative pressure, and to exhaust moisture and lint laden air from the dryer using positive pressure. Variations in design and components of the major design types, account for the differences in the efficiency in which they dry clothes and their ability to manage the byproducts of the drying process, i.e. moisture-laden air and lint.

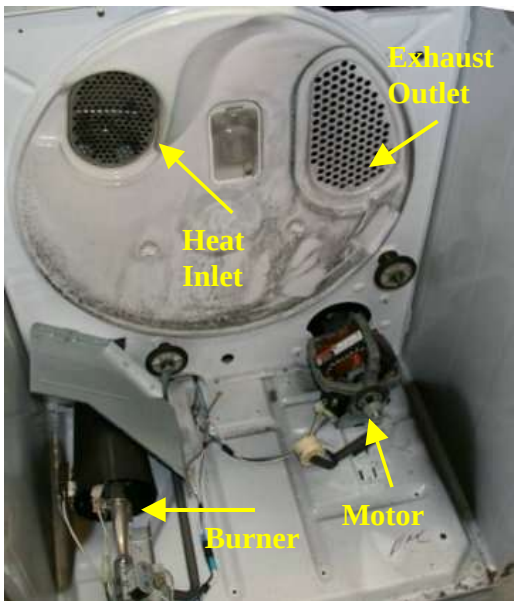
Whirlpool Design

Whirlpool has been manufacturing clothes dryers since the 1950's. Whirlpool's original design of clothes dryers uses a two-piece drum, of which the stationary rear wall of the drum is incorporated to an inner dividing wall within the main cabinet. This is known as the bulkhead. The cylinder of the drum rotates on two drum rollers at the rear, and on drum glides at the front. Warm air is drawn into the drum through a vertical heat duct located in the compartment between the bulkhead and the rear exterior panel of the cabinet, and enters through a small group of perforations located in the upper left section of the rear wall of the drum. In the majority of the Whirlpool electric dryers, the heating element is located within the vertical heat duct itself. In Whirlpool gas dryers, the burner is located below the drum in the base of the main compartment and is connected to the vertical heat duct. The moisture-laden air and lint is similarly exhausted from the drum through a separate group of perforations in the bulkhead and into the vertical exhaust duct, also installed in the compartment behind the drum. The blower housing and fan impeller are located at the base of the vertical exhaust duct. The lint screen is

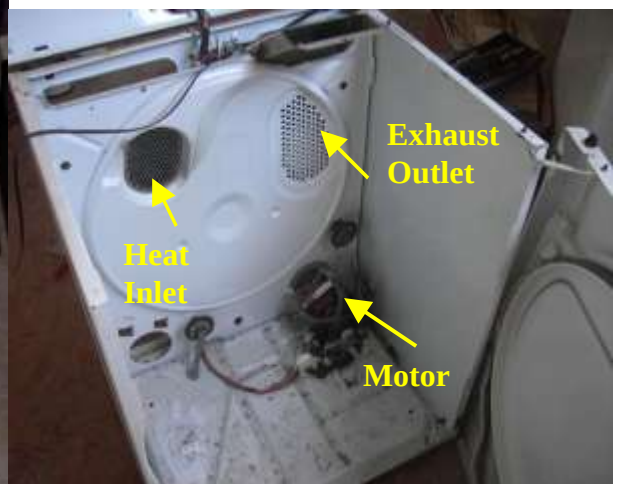
also located in the exhaust duct, and the lint screen is removed through an access door on the top of the dryer.







Whirlpool - Gas Dryer Design



Whirlpool - Electric Dryer Design

In the Whirlpool dryers, lint is primarily collected in the exhaust duct where the lint screen is positioned. A significant collection area of lint is typically observed at the base of the exhaust duct, at the 90° turn where the duct interfaces with the fan impeller. There are no ignition sources near the lint screen or at the base of the exhaust duct, as the fan motor is divided from the fan impeller by the metal wall of the duct and rear bulkhead. It should be noted that the exhaust duct is constructed entirely of metal and not of plastics that would add additional fuels should a fire occur.

The standard capacity electric models have their heating elements compartmented within the vertical heat duct, which runs upward within the compartment to the rear of the drum behind the bulkhead. The base of this heat duct is open, allowing not only cool air to be drawn in through the bottom for it to be warmed by the heating element, but also allows any lint that may escape into the vertical heat duct from the drum to fall into the base of the cabinet. There is no way for the lint to accumulate within the vertical heat duct and come into proximity with the heating element.

Some lint does escape the felt drum seals at the front and rear of the drum cylinder, and will collect within the base of the cabinet but generally does not accumulate to any appreciable depth. The motor and wiring are the only inherent ignition sources in the base of the cabinet in the majority of the electric models, with the gas models and high capacity electric models having the gas burner or heater assembly in the base of the cabinet. This allows for a slight potential for a lint fire, but because of the limited amount of lint that accumulates in the base of the cabinet and the fact that all of the components are metal, any lint ignition that occurs in the base of the cabinet cannot spread to the clothing in the drum or out of the cabinet.

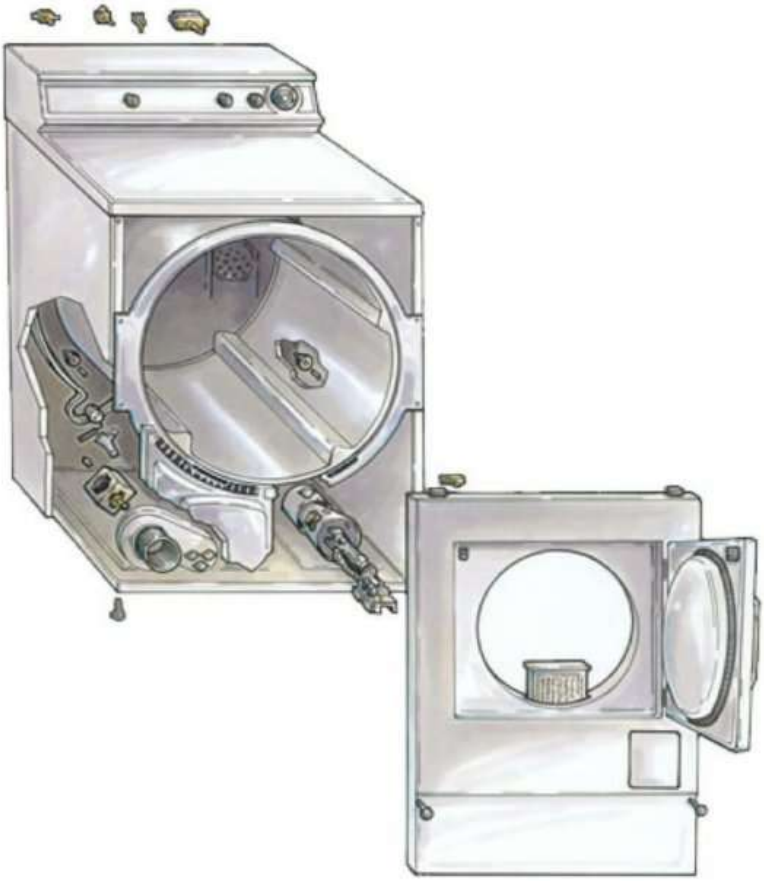
Unlike the subject Electrolux dryer, there is no major accumulation of lint near the heat source and the heat source is located further from the laundry load in the drum. This Whirlpool design uses better compartmentalization than the Electrolux design to separate the lint from the heat sources. The two piece bulkhead style drum and duct design does not allow for any lint to accumulate in between the heat source and the secondary spread fuels such as the laundry load and lint that is collected at the lint filter. For these reasons, the Whirlpool design is a better

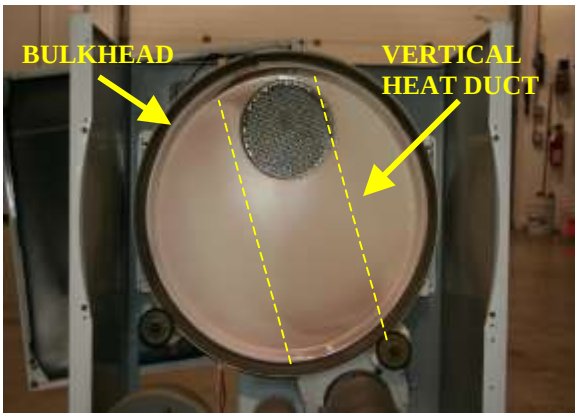
design alternative in the prevention of lint related fires. In electric models, the location of the heating element within a duct and the employment of a stationary rear wall of the drum/bulkhead completely eliminate fires caused by bearing failures, as a shifting drum can never contact the heating element. The reduced number of perforations on the rear bulkhead and increased linear distance between those perforations and the heating element virtually eliminates fires caused when foreign objects contacts the heating element. In addition, most of the models manufactured using this Whirlpool design use very few plastic components and both the vertical heat duct and exhaust ducts are metal.

It should be noted that Whirlpool has purchased Maytag and no longer uses the design described above, but rather the Maytag design that will be discussed in the next section.

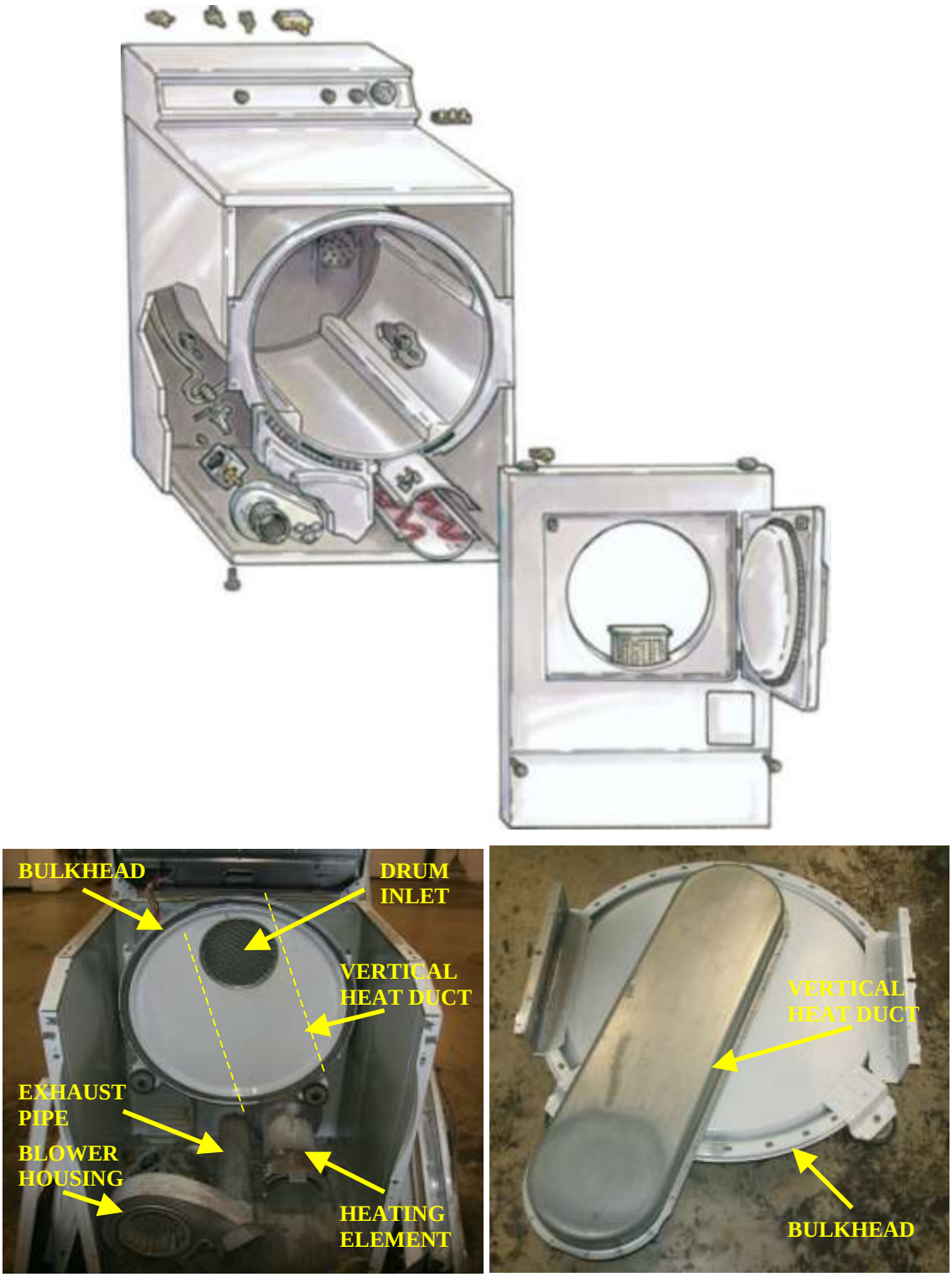
Maytag Design

Maytag has been using the following design of dryer since the 1960's. This is a hybrid design that incorporates features of both the Whirlpool design, as discussed above, and the Electrolux/General Electric design, which will be discussed next. These dryers have the same two-piece drum (bulkhead design) and vertical heat duct features of the Whirlpool, but the exhaust is drawn through the lint filter and trap duct assembly similar to that of the Electrolux/GE dryers. The drum cylinder is fully supported at the front and rear by bearing wheels. In both electric and gas models, the gas burner assembly or electric heating element are located in the lower right section of the base of the cabinet, and heated air is carried into the drum via the single vertical heat duct.





Maytag - Gas Dryer Design



Maytag - Electric Dryer Design

In the Maytag design, the main location where lint accumulates is on the exhaust side of the drum, within the trap duct that connects the lint screen/lint trap to the blower housing. There are

no ignition sources located within the trap duct. Like the Whirlpool design, the Maytag dryers do allow for minor leakage at the front and rear drum seals for lint to collect in the base of the cabinet.

And also like the Whirlpool design, the two-piece bulkhead design of the drum and duct does not form any void spaces where any significant accumulations of lint can collect behind the drum. Therefore the Maytag style of design has greatly improved fire prevention properties over the Electrolux design, in that the compartmentalization of the components do not allow lint to accumulate between the heat source and the secondary fuel loads, such as the laundry in the drum or lint collected at the lint trap.

In regards to fire hazards associated with the ignition of lint by the heat source in the base of the cabinet, lint can still enter the heater/burner assembly and become ignited. However, any ignited lint that has a small enough mass that would allow it to become airborne and be pulled horizontally through the heater/burner tube, turn a 90° corner, travel upward through the two foot length of vertical heat duct and make another 90° turn into the drum, would lose the majority of its heat energy along the way. This significantly reduces the likelihood that a lint fire caused by ignition at the heat source (gas burner flame or energized heating element) will occur in the Maytag designed dryer. In addition, there are no areas where secondary fuels (lint) can collect between the heat source and the laundry load.

In electric models, the location of the heating element within a duct in the base of the cabinet and the employment of stationary rear wall of the drum/bulkhead completely eliminate fires caused by bearing failures, as a shifting drum can never contact the heating element. The reduced number of perforations on the rear bulkhead and increased linear distance between those perforations and the heating element eliminates fires caused when foreign objects contacts the heating element.

The Maytag design of dryers used to contain a significant quantity of plastic components over a decade ago. This primarily included the lint screen and trap at the front of the drum, the trap duct that connected the lint trap to the blower housing at the lower front corner, the blower

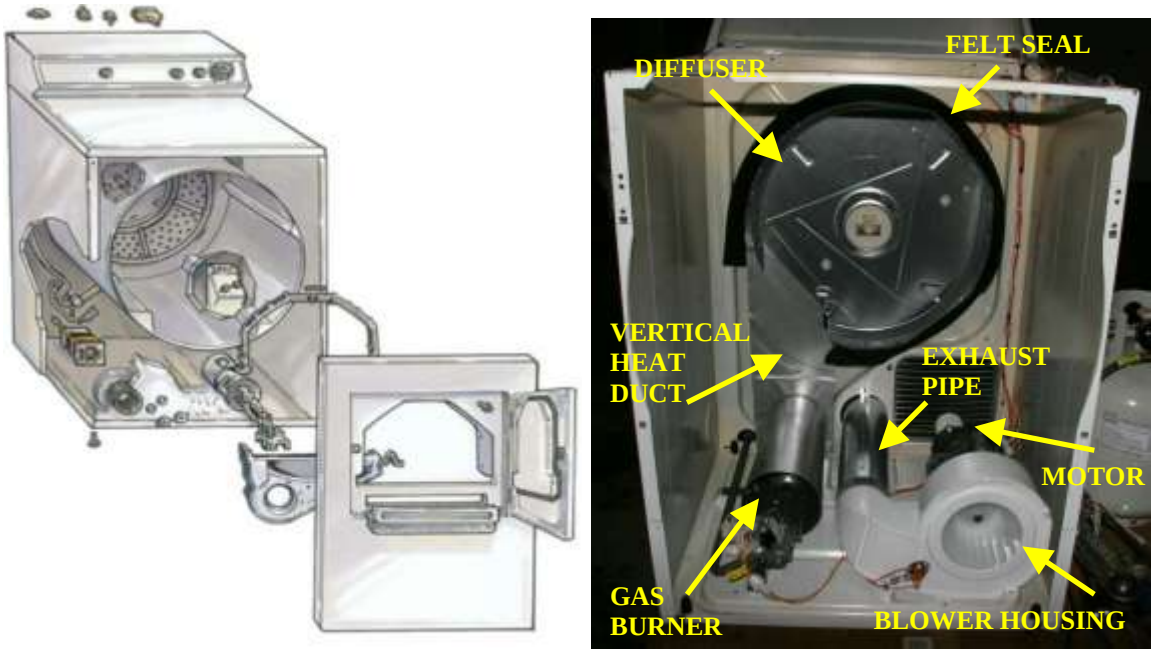
housing and the fan impeller itself. On some models the blower housing had a metal front face. Additionally, some Maytag dryers had a plastic panel on the interior of the drum door. Depending on the year and model, as well as the manufacturer specifications, the plastic components had varying HB (Horizontal Burn) or VB (Vertical Burn) fire resistive properties. There is a minimum fire resistance rating required under the Underwriters Laboratories Standard for Clothes Dryers, UL 2158. However, Whirlpool and Maytag have gone above and beyond this minimum standard in more recent model years to reduce the potential for fire growth and spread, either by using plastics with higher resistance to fire or by going back to all metal components, such as the metal trap duct found in the majority of the products. This is a clear indication that Electrolux's competitors have re-evaluated their designs and have taken the initiative to reduce the likelihood of fires in their dryers escaping should they occur for any reason.

It should be noted that Whirlpool purchased Maytag in 2006 and now all Whirlpool dryers share the same common elements of this design. In fact, this is the most prevalent design of dryers in the marketplace today. This design is not only found in Maytag and Whirlpool dryers, but also LG, Samsung and Electrolux's newest design of dryer, such as the Affinity 7.0, which will be discussed later on in detail in the Design Analysis section of this report.

Electrolux / General Electric Design

Electrolux dryers, such as the subject dryer, are similar to the original General Electric design of dryers that originated in the 1950's. This dryer uses a one-piece drum with perforations spread uniformly along the rear of the drum. The drum rotates on a single, center mounted drum pivot at the rear and drum glides at the front. Warm air is introduced through the rear of the drum via the heater housing or heater pan mounted directly behind the drum. Another indicator of this design type is the lint screen mounted at the lower front portion of the drum opening. As our research indicates, General Electric stopped manufacturing their own dryers in 1999, however, Electrolux manufactures dryers of a similar design under their own names including Frigidaire, Imperial, White-Westinghouse, Gibson, Kelvinator and Tappan and also re-branded under other brand names, such as General Electric and Sears-Kenmore.

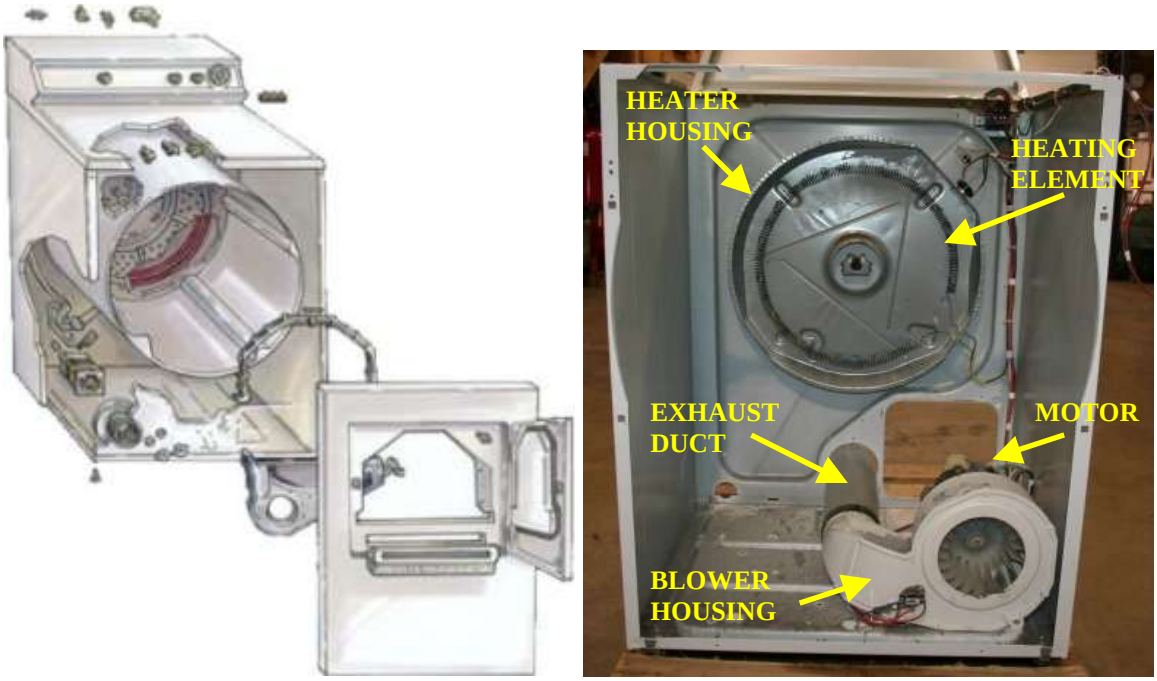
The Electrolux gas models have a gas burner assembly located in the lower left portion of the cabinet. Heated air is drawn through the burner tube and up into the shallow, circular heat diffuser behind the drum through the vertical heat duct that connects these components. The heat diffuser is approximately the same diameter as the drum and is equipped with a felt seal that creates a sealed void space between the diffuser and the rear wall of the drum. The heated air is then drawn forward into the single-piece drum, through the laundry load rotating inside of the drum, and into the lint filter assembly that houses the lint screen at the lower front portion of the front drum opening. The air is then drawn into the constricted area of the trap duct that connects the lint filter assembly to the blower housing. Here the airflow transitions from vacuum to positive pressure and the warm air is pushed out of the dryer through the short section of metal exhaust pipe.



Electrolux/General Electric - Gas Dryer Design

The Electrolux electric models have a resistive coil-heating element located in the circular heater housing attached to the rear wall of the cabinet. The heater housing is approximately the same diameter as the drum. Ambient temperature air is drawn radially through the gap between the edges of the heater housing and the rear of the drum. There is no felt seal such as the one on the

gas Electrolux dryers that seals the gap between the drum and heater housing, as it necessary to pull air into the heater pan equally around its circumference. Just as in the gas model, the heated air is then drawn forward into the single-piece drum, through the clothing load rotating in this drum and into the lint filter assembly housing the lint screen at the lower front portion of the front drum opening. The air is then drawn into the constricted area of the trap duct that connects the lint filter assembly to the blower housing. Here the airflow transitions from vacuum to positive pressure and the warm air is pushed out of the dryer through the short section of metal exhaust pipe.



Electrolux/General Electric - Electric Dryer Design

As discussed above in the section entitled **Accumulation and Ignition of Lint In the Electrolux Dryer**, the heat diffuser and rotating rear drum wall of the Electrolux design promotes the accumulation of lint behind the drum, and particularly in the heat diffuser or heater housing, where it collects at or near the heat source. The perforations across the entire rear wall of the drum allow for lint to enter this area that it essentially a hidden void space that cannot be seen by the user to evaluate the hazards associated with the collection of lint in relation to the position of the heat source. In electric models, the heating element is located directly behind the rear wall of the drum and its attached baffle, areas where lint has been observed to collect in

substantial quantities. In gas models, although the burner assembly is located in the base of the cabinet, the lint accumulates on the horizontal surface of the heat diffuser immediately adjacent to the opening at the top of short length of vertical heat duct. The lint that collects here remains constantly exposed to the burner flame and the heated air carried upward from the burner assembly. If the lint becomes dislodged it can drop into the vertical heat duct and can be directly ignited by the burner flame. If it encroaches over the vertical heat duct, the heated air itself can be sufficient to ignite the lint under certain conditions. Under certain conditions, an abnormally behaving flame can also extend upward into the heater pan and ignite the lint collected there.

Evaluation of Lint Accumulation: Ball-Hitch vs. Bulkhead Designs

The Wright Group has examined numerous dryers of other alternative designs by other manufacturers as well as the Electrolux Ball-Hitch design. It is not being contended that the alternative design of dryers accumulate less lint in the cabinet, but rather that the lint that does specifically accumulate behind the drum near the heat source, where it is most likely to be ignited by the gas burner or heating element. Attached are demonstrative photos showing the interior of Whirlpool and Maytag clothes dryer that employ the Bulkhead design. It should be noted in these photographs that, while lint can accumulate inside the any dryer cabinet, in the Bulkhead design it does not accumulate in the same position in areas where the lint is at risk of contacting the heat source. Also, the alternative Bulkheads designs do not have a void space behind the drum like those found in the subject Electrolux design, where lint has been shown to collect. Please refer to earlier sections of our report for views of the exemplar Electrolux dryers for comparison to these other manufacturers' designs.















Photos of Whirlpool & Maytag Exemplars

Also included for comparison are photographs of the Ball-Hitch design employed by GE, CAMCO and MABE, which share many features with the subject Electrolux dryer design. It should be noted in this substantially similar design, quantities of lint are regularly observed in the same area to the rear of the drum and in proximity to the heat source. These areas include the rear of the drum, the interior of the heat shield/baffle that attaches to the rear of the drum and in proximity to the vertical heat duct in the gas dryers and in proximity to the heating element in the heater pan of the electric dryers.











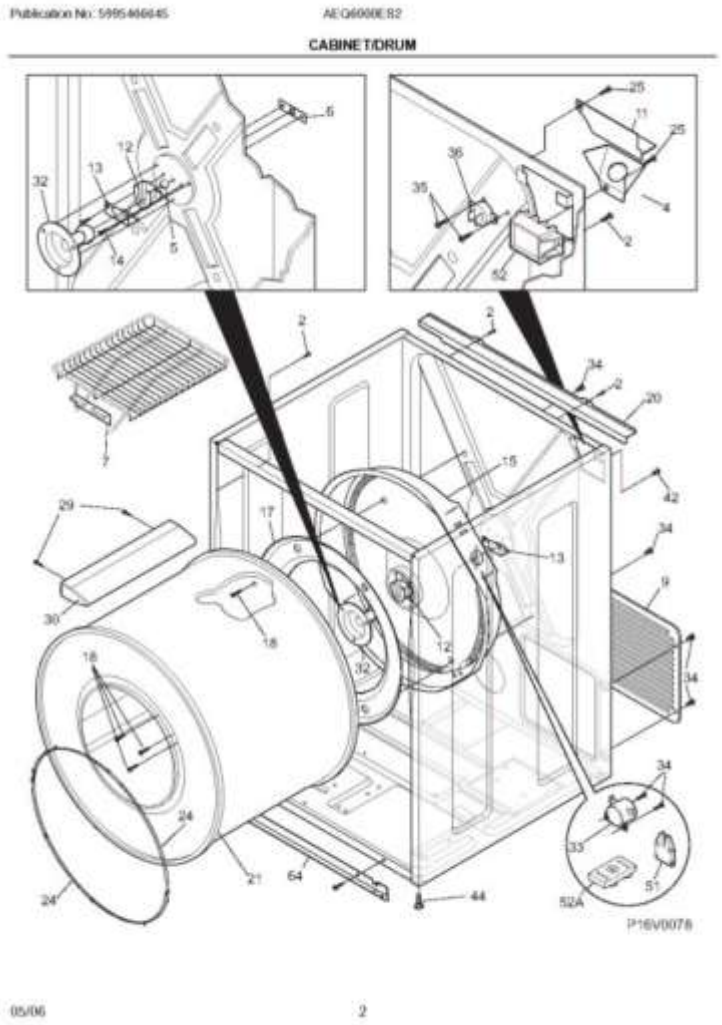


Photos of GE Exemplars with Lint

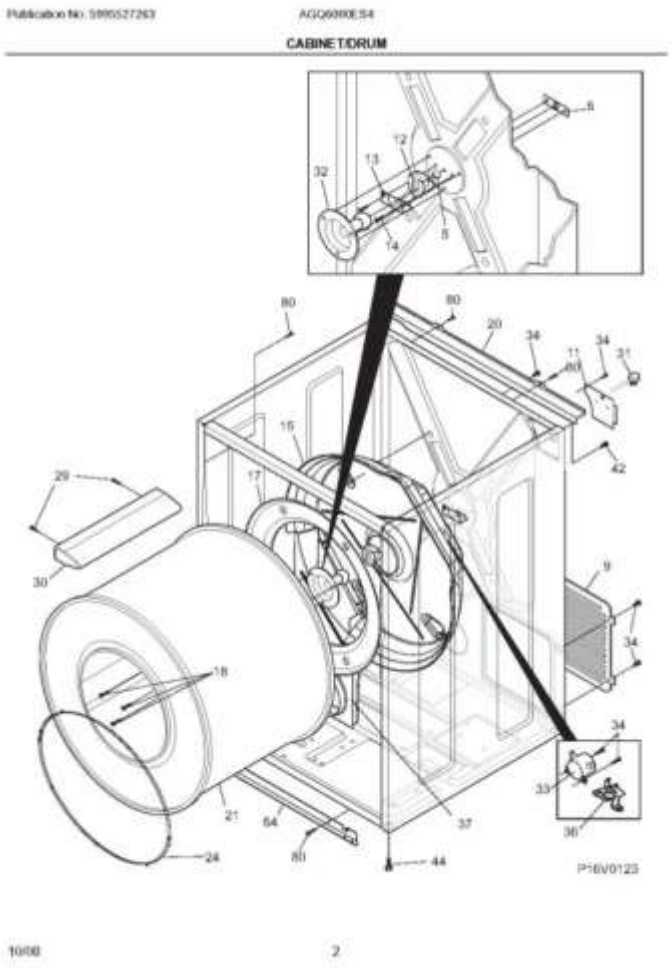
Comparison of the various designs of dryers revealed that the Electrolux/GE Ball-Hitch design types of dryers accumulated substantially more lint in critical areas where it is more probable that a fire will originate than in the alternative designs used by Whirlpool and Maytag Bulkhead designs. This lint accumulation was particularly noticeable in areas at or near the heat sources, such as behind the drum of the Electrolux/GE dryers.

New Design Incorporated by Electrolux: Frigidaire Affinity 7.0

During our recent years of analysis, we have continued to evaluate the dryers manufactured by Electrolux and released into the retail market. With the popularity of front loading washing machines, Electrolux altered their standard design for certain models of dryers to include a modified front panel and updated controls that match the fit and finish of their newer front loading Affinity washing machines. These dryers initially employed the same major internal components as observed in the subject dryer, such as the one-piece drum with perforations along the entire rear wall, heater pan behind the drum on the rear wall, etc. Examples of The Frigidaire Affinity 5.7/5.8 Cu. Ft. series parts diagrams are shown below:



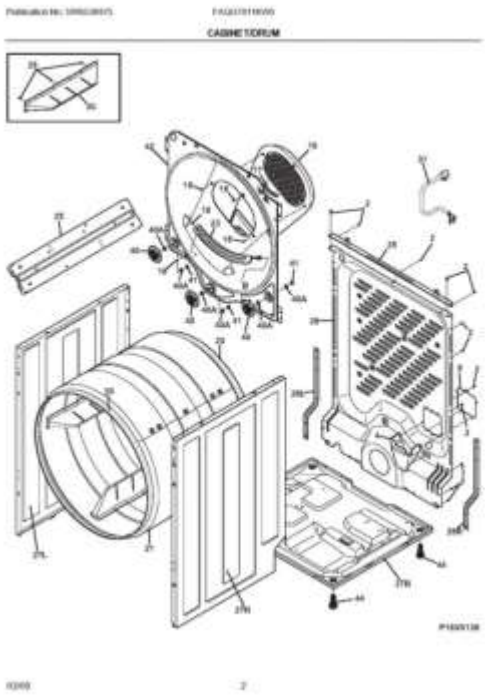
Frigidaire Affinity 5.7/5.8 Cu. Ft. Electric Dryer

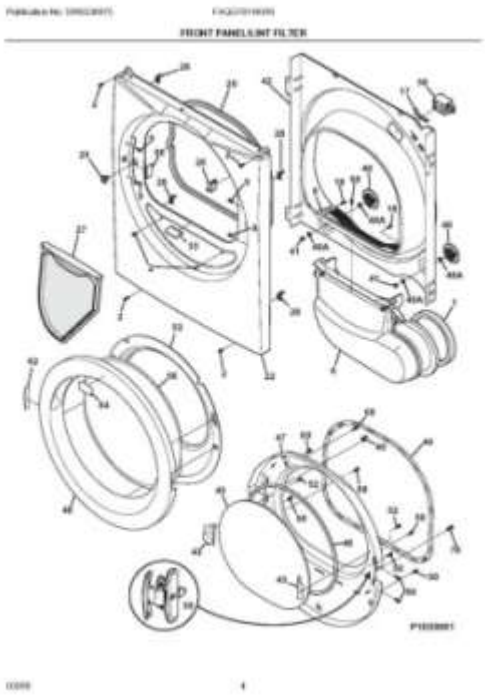


Frigidaire Affinity 5.7/5.8 Cu. Ft. Gas Dryer

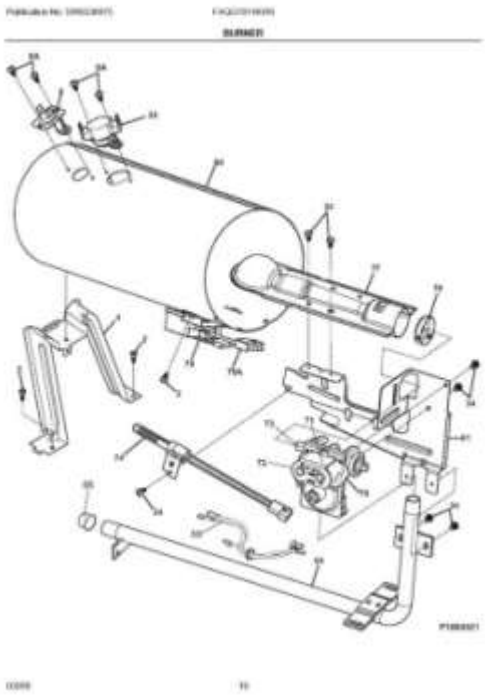
Electrolux, in 2008, introduced a new design type for its Frigidaire Affinity models, which is manufactured in Juarez, Mexico. This bulkhead design is essentially a copy of the Maytag design type outlined in the previous comparison of design types earlier in this report. As of 2011, this design has replaced the ball-hitch design of dryer completely. Electrolux has shut down their Webster City, Iowa plant where the ball-hitch dryers were manufactured. The front panel is of a similar design to the 5.7/5.8 Cu. Ft. models above and matches the front-loading washing machines. The internal components have been almost entirely changed, with the only major components retained being the blower housing, fan impeller and motor assembly. The drum has been completely changed to the two-piece bulkhead design with a stationary rear wall, with a reduced number of perforations. There is a single stationary duct that carries heated air

from the gas burner assembly or heating element, which are both located in the lower left portion of the cabinet. The Frigidaire Affinity 7.0 Cu. Ft. series parts diagrams are shown below:

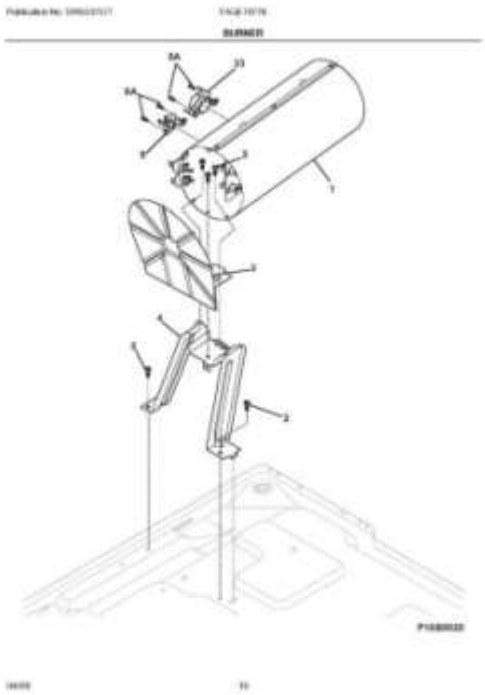




Affinity 7.0 Cu. Ft. Cabinet, Drum, Bearings Front & Rear Panel



Affinity 7.0 Cu. Ft. Gas Burner



Affinity 7.0 Cu. Ft. Heating Element

Below are photos of the new design, in a Frigidaire Affinity 7.0 Cu. Ft. Electric Dryer. The only difference in the gas model is that the heating element is replaced with a gas burner assembly.

Frigidaire Affinity 7.0 Cu. Ft. Electric Dryer

It is the opinion of the Wright Group that the dryers manufactured by Electrolux using the 7.0 Cu. Ft. dryer design (Bulkhead) are significantly safer in relation to property loss, personal injury and death than their previous dryer design (Ball Hitch) was. This new design does not promote the build-up of lint in close proximity to the heat source. This design uses the same concept as the Maytag design, a proven design used by the majority of manufactures in today's dryer market. The phasing out of the old design is noteworthy, but does not eliminate the risk of fire hazard in the millions of Electrolux dryers (Ball Hitch) of the 5.7/5.8 Cu. Ft. designs in circulation today. The subject dryer was the old design (Ball Hitch) that allows lint to collect at or near the heat source and is a fire hazard.

Evaluation of the Fire Risk Associated with the Subject Electrolux Design of Dryer

The subject dryer designs employed by Electrolux in their 5.7/5.8 Cu. Ft. dryers were evaluated and the following hazards related to the risk of fire were identified:

1. **Ignition of lint by the heat source in gas or electric models:** As discussed at length in the examination of exemplar dryer section, lint accumulation within the cabinet in areas not viewable or accessible to the end user is well documented. The actual design incorporated by Electrolux has been observed to collect a higher volume of lint at the heat source than the alternative designs such as the Maytag and Whirlpool dryers. The most dangerous collection areas where lint accumulates are those areas that are proximate to the heat source. This lint becomes the first ignited fuel and can spread fire to other

combustibles within the dryer including the plastic components of the trap duct/blower housing, and the clothing load.

In the case of gas dryers, this area is the sealed void space formed between the heat diffuser pan on the rear of the cabinet and the back of the drum. The lint that accumulates in this area has been recorded to be up to several inches deep, and can encroach upon the vertical heat duct that carries heated air from the burner to this void space. The lint can be ignited in three ways. The first is ignition from the hot gases produced by the combustion process within the burner assembly. The second is direct ignition by the burner flame when lint falls into the vertical heat duct and/or burner tube. The third is that lint accumulation on the air intake for the burner assembly alters the air-to-fuel ratio resulting in a taller flame being produced by the burner that extends up into the lower section of the heat diffuser via the vertical heat duct directly igniting lint collected within the heat diffuser pan.

In the case of electric dryers, there are two areas where dangerous accumulations of lint are typically found. The first is where lint accumulates on the rear face of the drum where the ventilation perforations form a rough irregular surface for lint to collect and inside of the heat shield attached to the rear of the drum. The second is within the heater housing or behind the housing; around the bearing/hitch assembly at the center of the heater housing or on the horizontal lip at the 6 o'clock position. Lint that accumulates in any of these areas can detach during the operation of the dryer and become ignited when it contacts the energized heating element. Once the burning lint is pulled into the rear of the drum and heat shield, the lint that collects there can ignite, spreading fire to the clothing or to the lint filter/trap duct/blower housing assembly where a heavy accumulation of lint is typically observed.

2. **Failure of the Drum Bearing Assembly:** This fire hazard is limited to electric models only. The rear of the drum is supported by a single point bearing assembly consisting of a metal ball pivot affixed to the center of the drum which rotates in the hitch assembly, consisting of a plastic or nylon bearing material supported by a metal bracket, affixed to

the rear of the cabinet at the center of the heater housing/diffuser assembly. If the plastic bearing material fails, the metal pivot rotates directly against the metal bracket of the ball/hitch resulting in scoring of the pivot shaft. Over a period of time, the scoring weakens the pivot until it is severed or breaks, allowing the drum to shift. The rear of the metal drum and/or attached heat shield is normally located less than one inch from the heating element, but under these circumstances the shifted drum can contact the heating element. If the heating element is energized, a ground fault occurs between the heating element and rear metal drum and/or baffle. The heating element typically breaks and a section of the heating element in the form of molten metal slag is released. Since the dryer is operating at the time, the airflow is being pulled into the rear of the drum, drawing this hot slag into any lint collected at the rear of the drum and/or into the clothing load, resulting in a potential fire. In addition, the shift in the drum will allow for lint that collects within the baffle/heat shield and on the rear of the drum to migrate closer to the heating element or even come into direct contact with the heating element and be ignited.

3. **Heating Element Ground Fault by Foreign Object:** This fire hazard is limited to electric models only. In the subject design of the electric dryers, metal objects such as bobby pins, bra under wires or similar items can be accidentally introduced along with the clothes load and can work their way through one of the ventilation openings on the rear wall of the drum and enter the heater housing. If these objects contact the energized heating element a ground fault can occur. Similar to the inception of fire in the bearing failure scenario, the hot molten slag produced by the arcing event can ignite the combustible lint at the rear of the drum or the clothing load itself.

Further Discussion on Causes Related To Electric Dryers

The location of the heating element behind the drum in Electrolux Electric dryers causes additional fire safety concerns. Exemplar dryers examined by The Wright Group have resulted in the documentation of two separate ignition scenarios unique to electric dryers of this design type.

The first is a bearing failure that results in fire when the single rear bearing assembly that suspends the drum from the center of the heater housing fails, causing the rear of the metal drum and its clothing load to shift from its original position. When this occurs while the dryer is operating, the metal baffle/heat shield attached to the rear of drum contacts the energized heating element located approximately one inch from the rear of the drum, which results in a ground fault. This electrical short emits hot molten metal into the cabinet in the area at the rear of the drum. Any lint accumulated on the rear of the drum or within the cabinet can be ignited. The hot molten metal can also pass through the perforated ventilation openings in the rear of the drum and ignite the clothing load, particularly if the load is dry. The ability for the molten metal to be drawn into the rear of the drum is compounded by the negative pressure caused by the operating blower fan assembly, pulling air from the direction of the heating element behind the drum, into the clothing and toward the lint filter assembly at the front of the drum. It should be noted that other electric dryers of the other manufacturers' design types do not have their heating element located in this same location. Instead they are located in a metal duct in the cabinet below the drum. This eliminates the possibility of a bearing failure of any caliber to allow the drum to contact the heating element under any circumstances.

Example of Damage Related to a Bearing Failure

The second fire cause scenario also relates to the heating element location directly behind the drum. Metallic objects from the clothing load can pass through the numerous ventilation perforations in the rear of the drum and enter the heater housing. If any of the items should contact the heating element while the heating element is energized, an electrical short can occur. The ground fault of the object between the heating element and any grounded metal component of the dryer, such as the heater housing or rear of the drum, would also result in the release of hot molten metal lint accumulated within the cabinet or into the air stream pulling the air from behind the drum into the lint accumulated at the rear of the drum or clothing in the interior of the drum. Ignition of lint and other combustibles can also occur when the foreign object forms a high resistance connection at the heating element. Items associated with this fire cause includes any clothes that contain metal objects, in particular under wire bras, or any small foreign objects accidentally left in the pockets of clothing, such a bobby pins.

Example of Foreign Objects Contacting the Heating Element

Fire Containment Issues Related To Combustible Components

The dryers manufactured by Electrolux are all equipped with plastic trap duct/blower housing assemblies. These plastic components contribute significantly to the inherent fuel load within the dryer and provide a secondary fuel to any lint that is ignited within this restrictive assembly. In addition, the plastic trap duct/blower housing does not assist in containing the fires that propagate from the ignition of the collected lint within this component. Furthermore, once ignited, these plastic components will catch fire and melt. This allows them to flow out of the metal enclosure of the dryer and pool outside, assisting in fire spread to nearby combustibles outside of the dryer.

The exemplar dryers analyzed indicate that the door gasket used to seal the door in the front of the dryer opening fails when it is subject to fire. The gasket melts and burns away and allows fire to escape from the drum after the clothes load is ignited.

The door latch assembly on the unburned and burned dryers indicates that the latch pin is manufactured out of steel and mechanically fastened to the door assembly. The latch pin catch, which is located in the front of the cabinet, has the majority of its components manufactured out of plastic. When attacked by fire, this plastic melts and burns away. The result of the decomposition of the door latch base allows the latch mechanism to be ineffective at keeping the dryer door closed. This results in the dryer door being able to open during the fire event. When the dryer door opens, the fire escapes out of the dryer drum location.

In viewing numerous dryers involved in fires, we have observed many instances where the fire has been contained primarily to the drum and we have also inspected dryers where the fire has escaped out of the drum due to the failed gasket and door latch assembly. The lint at the rear of the dryer heater housing or diffuser has caught on fire and the fire has traveled through the rear of the drum and ignited clothes. In some instances, the fire was partially contained to the dryer assembly and other instances the fire was able to escape the dryer assembly through the front panel’s door opening and the penetrations in the top of the cabinet at the control console

location. Fire also escaped the cabinet and spreads to nearby combustibles as the plastic trap duct and blower housing catch fire, causing the melted and burning plastic to flow from the cabinet to the exterior where this burning plastic can ignite other materials adjacent to the dryer.

It is the opinion of the Wright Group that all internal component materials would be improved by manufacturing them from materials other than plastic, when possible. This would assist in fire containment and not add additional spread fuels. The UL 2158 standard does allow for manufacturer's to use plastic materials that are approved under the minimum requirements of the standard. However, the standard does not account for dryers that have accumulated lint over their life. The plastic components used in Electrolux's dryers are separated from any heat sources by the location of the component parts and are rated for fire resistance per the standard. This means that the plastic components won't melt or ignite from the heat produced during the operation of the dryer under normal operating conditions. However, the addition of lint inside the cabinet adds additional first fuels that, when ignited, are in direct contact with the plastic and release sufficient heat energy to ignite said plastic components, regardless if they meet the minimum fire resistance ratings or not.

As an example, if there was a loose connection on the power cord of an electric dryer and resistance heating was to occur at that poor connection, the insulation on the wiring would char due to the inherent fire inhibitors added to the insulating materials during manufacture, but no open flame would be produced. On the other hand, if the connection area was covered in accumulated lint, the overheated connection could ignite the lint and the lint would generate open flame. The burning lint would release enough heat energy to drive off the fire inhibitors and the wire insulation would be more readily ignited than with heat alone.

The lint that collects in the dryer at or near the heat source, by nature of its defective design, allows for an easily ignitable first fuel to collect in the area of the heat source. Once ignited, the burning lint spreads to the secondary fuels within the dryer. These secondary fuels include the load, additional lint accumulated throughout other areas of the dryer's interior, and ultimately to the plastic components installed by the manufacturer.

Wright Group's Proposed Design for the Alternative Use of Materials

Using materials that would survive direct flame impingement to prevent the spread of fire from the interior of the dryer would reduce the amount of additional fuels that contribute to the growth of fire within the cabinet, assist in the prevention of fire spread from the interior of the dryer and improve the overall fire containment and spread issues associated with the Electrolux design. The following components would be better served through the use of alternate materials:

Replacing the plastic door latch with an all steel assembly

Replacing the plastic door gasket with a flameproof fibrous gasket

Eliminating the use of plastic end caps and related combustible components at the control console, or replacing them with steel


Replacing the plastic trap duct and blower housing with steel components




Replacing the thermoplastic fan with a thermo set plastic. Thermo set plastic is more resistant to ignition than thermoplastics, and chars when exposed to heat instead of burning and pooling.

Replacement of the plastic bearing material with steel bearing materials

Wright Group's Design Alternative for Electrolux Dryers

A complete redesign of the Electrolux dryer has been completed by Electrolux to supply dryers to the public. These new dryers use the Bulkhead design and are less prone to fires. The subject Electrolux design dryers (Ball Hitch) have been replaced with a copy of the Maytag design type (Bulkhead) that does not allow for lint to collect behind the drum near the heat source. This eliminates fires caused by the collection of lint behind the drum at the heat source, bearing failures, and drastically reduces the possibility that a fire can be caused by a foreign object contacting the heating element. We cannot speculate as to the reason, but Electrolux has already taken the initiative to begin the production of a dryer that emulates the safer design (Bulkhead) of dryer, as outlined by the Wright Group in our proposed redesign and used by the majority of manufacturers for retail production in today's appliance market, including Maytag, Whirlpool, LG and Samsung. The production of their newly designed dryer (Bulkhead) began in their Juarez, Mexico Plant in July 2008. Carl King, Electrolux's own in-house Safety Engineer, has stated that there have been no reports of any fires in their new design dryer that is based on the Bulkhead design. Subsequently, production of the subject (Ball Hitch) design of their dryers was terminated at Electrolux's Webster City, Iowa, washer/dryer manufacturing plant in March 2011.

Wright Group's Design for a Guard to Prevent Lint Ignition Fires

The most common fire cause related to Electrolux dryers is the ignition of lint by the heat source. Without re-designing the entire dryer, we have designed a remedy to eliminate the possibility of a fire being caused by the ignition of accumulated lint behind the drum. The requirement was to make this possible in a cost effective and simple manner that could be retrofitted to existing dryers in the field to improve the safety of these devices.

The Wright Group has constructed two design alternative prototypes containing a guard to separate lint behind the drum from coming into contact with the heat source. These prototypes are identified as RONCO 3 and RONCO 4. These prototypes are based on an Electrolux gas platform. The Wright Group employed principles and designs that have been in use for over 40

years. Performance evaluation of these dryers confirmed that RONCO 3 and RONCO 4 perform substantially similar to their gas and electric Electrolux counterparts. For our performance test data as it relates to RONCO 3 and RONCO 4 please see **Appendix V**. Additional testing was performed on RONCO 3 to evaluate the effectiveness of the guard in preventing lint that collects behind the drum from igniting by contacting the heat source. Under the testing, no lint was able to enter the vertical heat duct and no lint was ignited within the heater pan. For the data associated with this lint accumulation test on the RONCO 3 prototype, please see **Appendix VII**.

The basic concept actually simplifies production by using the continuity of parts for both gas and electric models. It should be noted that many components are interchangeable between gas and electric models, such as the cabinet, control console components, drum, motor assembly, the blower housing, trap duct, lint filter, etc. The differing components include the 240 volt vs. 120 volt wiring harnesses, the heater housing/element assembly vs. burner/diffuser assembly, thermal protection devices and the heat shield/baffle assembly in some cases. The alternate design modification concept uses the bulk of the gas dryer components, the difference with the electric models being that they would use a package-style heating element in place of the gas burner and a 240 supply. This would save manufacturing costs by reducing separate tooling and assembly processes.

The potential for a fire to be caused by the ignition of lint that collects in the diffuser by the burner flame is remedied by the installation of a very simple guard manufactured out of sheet metal. The concept is to simply form a guard that lengthens the vertical heat duct from where it enters the diffuser at the 7 o'clock position and extend it up to the 1 o'clock position. Any of the lint that accumulates at the 6 o'clock position is blocked from falling into the vertical heat duct/ burner tube by the guard, even if the lint accumulates to several inches in depth. Conversely, if any lint accumulates on the gas burner assembly and changes the flame characteristics resulting in a flame that reaches up into the diffuser pan, the flame cannot contact any lint accumulated at the 6 o'clock position. The guard forms an internal duct through which the air velocity remains higher than within the larger area of the diffuser pan, so lint cannot accumulate within the duct formed by the guard. The addition of a baffle to the right side of the shield creates an air gap to

eliminate the hot surface ignition of lint at the 6 o'clock position by conductive heating through the guard.

Below are photographs of the Wright Group's alternative design for the Electrolux 5.7/5.8 Cu. Ft. gas dryers. The alternative design for the gas model has been operationally tested using a large towel load and was found to retain the same average drying time as an unmodified Electrolux gas dryer.

Wright Group's Alternative Design for 5.7/5.8 Cu. Ft. Gas Dryers

The gas dryers manufactured by Electrolux for General Electric contained a similar guard that was used as the primary basis of this design. This guard was only installed in gas GE models, not in Frigidaire models. The Wright Group improved the design by enclosing the lower half, below the drum pivot opening and adding a baffle to prevent the ignition of lint that collects in the lower half of the heat diffuser. The exemplar dryer below was a General Electric gas dryer manufactured by Electrolux in December 2003.

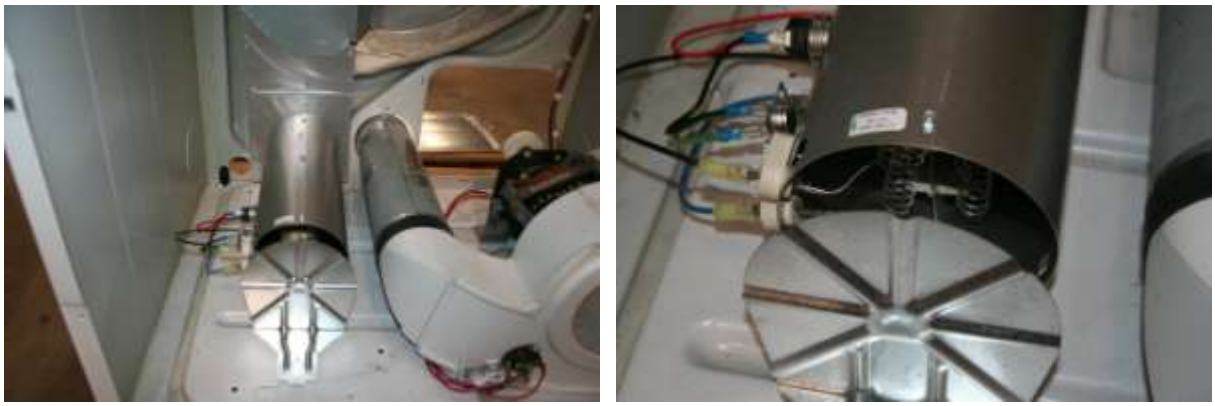
Electrolux Manufactured Guard in GE Gas Dryer Model DVL223GB5WW

The electric variation obtains additional fire safety benefits for the hazards associated with bearing failures and foreign objects. By using a linear style electric heating element located in place of the gas burner, the ring-style open heating coil behind the drum would be removed, and the alternate design would allow the package-style coil to be protected in an open ended tube in the base of the cabinet, far below the drum. This would completely eliminate fires caused by a bearing failure scenario, as the element would be protected from drum contact by the location change and the protective tube. The possibility of a fire caused by foreign object contacting the

heating element is also significantly reduced due to the increased distance and paths through which that object would have to travel. In addition, the heating element is relocated much further from the combustible lint that accumulates on the rear of the drum and clothing in the drum, so if any small piece of lint could possibly be ignited by being pulled into the heater assembly from the base of the cabinet, the burning lint is more likely to be consumed or use up its latent heat energy before it re-enters the drum to ignite the clothing or the lint downstream of the drum in the lint trap area. The final benefit of relocating the heating element to the base of the cabinet is the elimination of the need for the heat shield/baffle attached to the rear of the drum that normally collects a significant quantity of captured lint.

Below are photographs of the Wright Group's alternative design for the Electrolux 5.7/5.8 Cu. Ft. electric dryers. The alternative design for the electric model has been operationally tested using a large towel load and was found to retain the same average drying time as an unmodified Electrolux electric dryer.



Wright Group's Alternative Design for 5.7/5.8 Cu. Ft. Electric Dryers

Additional Safety Devices

We have also chosen to conceptualize possible remedies that Electrolux has failed to use basic safety engineering principals to address, which they commonly fall back on in the defense of their products when their experts determination as to the cause of these fires are contributed to "improper installation" or "improper maintenance". The Wright Group has had the opportunity to read several reports authored by Carl King, the Product Safety Engineer for Electrolux's Laundry Division, as well as reports by their outside fire origin and cause experts. Mr. King and his fire experts regularly opine that the fires that occur in the Electrolux dryers are either the direct result of, or significantly compounded by, the failure of the user to follow the manufacturer's instructions and/or the improper installation of the dryer and its external exhaust system.

As previously described in the review of basic safety engineering principals, it is the duty of the product manufacturer to attempt to reduce or eliminate fire hazards by design. Electrolux has ignored this on the subject dryer and chose simply to passively warn about the risk of fires associated with the failure to follow manufacturer's maintenance instructions and installation instructions. In response, we have created some conceptual engineering designs that incorporate not only active warnings that would be more recognizable by the user, but also safety devices that would force the user to service the dryers if they should reach unsafe operating conditions as alleged by the manufacturer, such as an exhaust blocked by a bird's nest. Electrolux now uses safety devices on some of their new style Bulkhead dryers to warn a user of reduced airflow.

Wright Group's Proposed Design for an Exhaust Monitoring Safety Device

Electrolux contends in many cases that a restricted exhaust was a major factor that contributed to the accumulation of lint within the dryer cabinet and that a properly installed and maintained exhaust would have prevented the fire. It is foreseeable that the manufacturer's instructions as to the installation and maintenance of the external exhaust system will not be read by the user or forgotten about. By designing and installing an engineered safety device, the manufacturer could better protect against fires that they have stated are proximately caused by external exhaust system issues. The Wright Group has designed such a safety device that could be used to monitor the performance of the exhaust system attached to the dryer.

The Wright Group design concept uses a high limit monitoring system. The monitoring system would evaluate the high limit switch when the switch opens. The purpose would be to actively evaluate the efficiency of the external exhaust system, a variable that the dryer manufacturer has no control of but recognizes as a fire hazard if the vent is restricted and causes lint to accumulate within the dryer cabinet near the heat source. If the external exhaust was not installed correctly or becomes restricted, and the airflow is not sufficient to properly exhaust lint from the dryer, the high limit switch will open. First, the switch will open and de-energize the heating element or gas burner, thereby removing the risk of fire, as the dryer will produce no heat. Secondly, an indicator light on the console will illuminate and instruct the user to "CHECK EXHAUST SYSTEM". Third an audible alarm will sound. Because this circuit is actively monitoring the temperature behind the drum, once the exhaust restriction is corrected, such as removing a blockage, the switch will close and normal operation will resume. This design would help reduce the accumulation of lint in dryers under circumstances where the exhaust system is deficient due to installation errors or lack of user maintenance.

Indicator Light for Exhaust Monitoring System

Other dryer manufacturers incorporate a similar type of safety in their residential clothes dryers. Some are based on a pressure sensing system that monitors the backpressure on the exhaust system exiting the dryer. Whirlpool's Cabrio line of residential clothes dryers incorporates "airflow detection capabilities" which monitors the exhaust system and provides an error code on the dryer control console to actively warn users of a restricted exhaust condition. The Whirlpool Dryer Venting Specifications (Document/Part No. W10100920B) describe the Error Code generated by the dryer and the steps required of the user to rectify the potential causes:

"AF" Code

Certain electronic dryer models have airflow detection capabilities. (See specific model product literature for details). If the airflow in the dryer is extremely low, an "AF" code will be displayed on the control panel. For single dryer venting systems, this code means that you may have a blocked or partially blocked vent or that your overall vent system length is too long. To resolve this issue:

■Check to see if the vent run from the dryer to the wall is crushed. Refer to the "Venting Requirements" section of the Use and Care Guide for more information.

■Confirm that the vent run from the dryer to the wall is free of lint and debris.

■Confirm that the exterior vent exhaust hood is free of lint and debris.

■Confirm that your vent system falls within the recommended run length and number of elbows for the type of vent you are using. Refer to the "Plan Vent System" section of the Use and Care Guide for details.

■Select a Timed Dry heated cycle, and restart the dryer.

■If the message persists, have your entire home venting run cleaned.

The following is an excerpt from the Manual for the Whirlpool Cabrio Electric Dryer, Model WED6200SW:

■ **"AF" (low airflow condition):**
The dryer will continue to run when this diagnostic code is present. Press any key to clear the code from the display and return to the estimated time remaining.

Try the following:
Clean lint screen.

Check to see if the vent run from the dryer to the wall is crushed or kinked.

Confirm the vent run from the dryer to the wall is free of lint and debris.

Confirm the exterior vent exhaust hood is free of lint and debris.

Confirm your vent system falls withing the recommended run length and number of elbows for the type of vent you are using. Refer to "Plan Vent System" in the Installation Instructions for details.

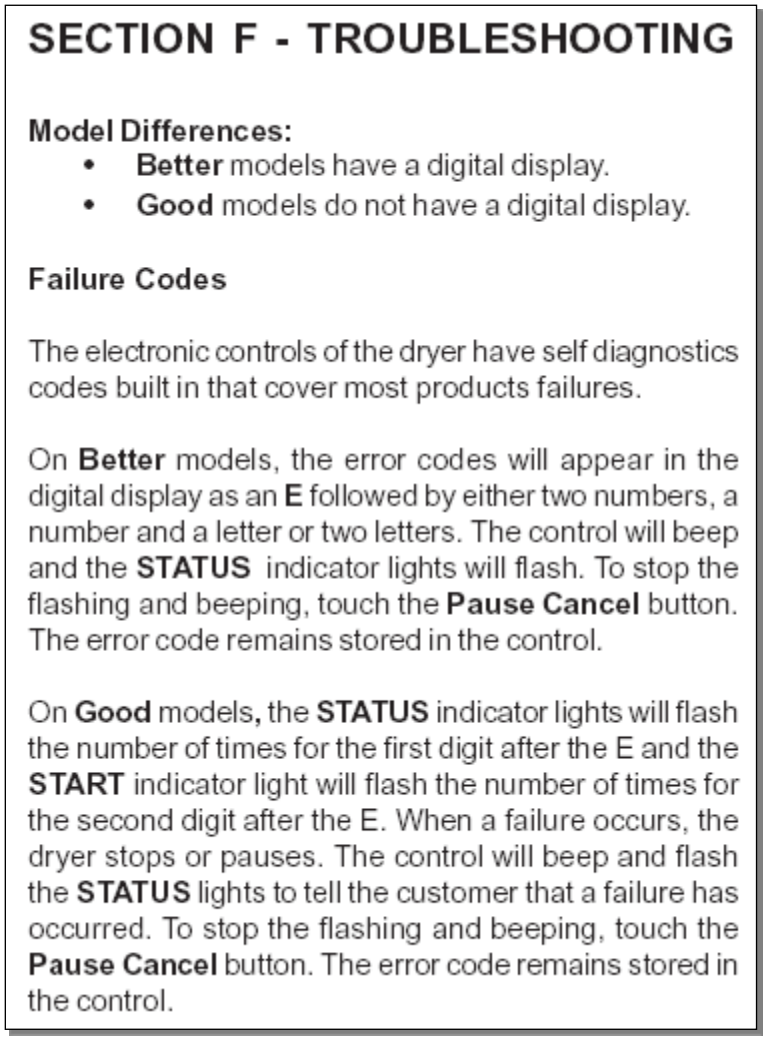
Select a Timed Dry heated cycle, and restart the dryer.

If the message persists, have your entire home venting run cleaned.

Whirlpool Cabrio Electric Dryer Manual

Electrolux has incorporated this safety into certain models of their clothes dryers. In reviewing product literature, Electrolux discusses a feature in their service manuals that monitors the high limit safety device. The high limit safety device is a thermal safety device that opens up at a specific high temperature and shuts the heat source off, preventing the area of the drum inlet from reaching too high a temperature. The activation of this safety switch is due to elevated temperatures behind the drum. These elevated temperatures are caused by reduced airflow through the appliance, i.e., oversized loads, restricted exhaust, poor internal seals, etc. However, this reduced airflow not only results in elevated temperatures in the rear of the drum inlet, but

also decreases airflow velocity, contributing to increased lint accumulation. Since 2005 or earlier, certain models of clothes dryers Electrolux produces, both the Ball-Hitch design and the Bulkhead design, incorporate a circuit that monitors activation of the high limit safety. Should the high limit cycle repeatedly due to reduced airflow over a certain period of time, an error code is produced on the electronic display panel indicating to the user that an abnormal condition is present and the appliance needs to be serviced. This feature was only available on some dryer models with high-end features, which Electrolux described as its "Good" and "Better" models, including the dryers that had either status indicator lights or an electronic control console. Electrolux failed to incorporate this feature on the base models of clothes dryers.



SECTION F - TROUBLESHOOTING

Model Differences:

- **Better** models have a digital display.
- **Good** models do not have a digital display.

Failure Codes

The electronic controls of the dryer have self diagnostics codes built in that cover most products failures.

On **Better** models, the error codes will appear in the digital display as an **E** followed by either two numbers, a number and a letter or two letters. The control will beep and the **STATUS** indicator lights will flash. To stop the flashing and beeping, touch the **Pause Cancel** button. The error code remains stored in the control.

On **Good** models, the **STATUS** indicator lights will flash the number of times for the first digit after the E and the **START** indicator light will flash the number of times for the second digit after the E. When a failure occurs, the dryer stops or pauses. The control will beep and flash the **STATUS** lights to tell the customer that a failure has occurred. To stop the flashing and beeping, touch the **Pause Cancel** button. The error code remains stored in the control.

Troubleshooting Excerpt from Electrolux 2005 Service Manual for 5.75 Cu. Ft. Dryer Gas & Electric Good and Better Models

E 8C	High limit thermostat has trip to many times in a certain amount of time.	Check for blocked lint filter, blocked exhaust, air leaks around air duct, broken blower fan blades, worn or loose drum seals, dryer installed in closet with solid doors or door seal not correctly seated.

Error Code Excerpt from Electrolux 2005 Service Manual for 5.75 Cu. Ft. Dryer Gas & Electric Good and Better Models

E8C	Too many trips in a period of time.	The safety (high limit) thermostat has tripped too many times within a certain period of program time.	Check for blocked lint filter, blocked exhaust, air leaks around air duct, broken blower fan blades, worn or loose drum seals, dryer installed in closet with solid doors or door seal not correctly seated.

Error Code Excerpt from Electrolux 2009 Service Manual for 5.8 Cu. Ft. Affinity and Gallery Series Gas and Electric Clothes Dryers

Wright Group's Proposed Design for a Periodic Maintenance Reminder Safety:

Electrolux contends that fires that occur due to excessive lint accumulation within the cabinet could have been prevented if the user followed the recommendation to have the interior of the dryer cleaned every 18 months by an authorized servicer. It is foreseeable that the manufacturer's instructions as to the recommended 18-month cleaning of the interior of the dryer will be ignored or misinterpreted in some cases. By designing and installing and engineered guard or safety device, the manufacturer could better protect against fires that they have stated are proximately caused by lack of user maintenance.

The first requirement would be for the manufacturer to quantify the 18-month time period they recommend to an equivalent number of drying cycles. For instance, the U.S. Department of Energy has indicated the average dryer usage is 416 times per year; this would equal 624 uses over 18 months. The statistical data and determination as to the monitoring method for the counter would ultimately need further review based on the manufacturer's longevity testing program. By installing a counter circuit that monitors actual quantifiable data such as the number of times the start switch was activated, the number of heating cycles, the number of drum revolutions, total hours of operation, etc., the arbitrary time factor for a maintenance requirement is removed. For example, a large family that uses the dryer 2-3 times per day may need to clean the interior of the dryer after only 12 months in order to remove the lint that is

known to accumulate near the heat source and in other areas unnoticeable and inaccessible by the average user, while a single person who dryers 2-3 loads per week may only require such cleaning after 36 months. The following design concept would be subject to the manufacturer's determination as to the recommended and required use of the appliance.

The Wright Group design concept uses a counter circuit, much like the odometer in every automobile manufactured for over 50 years. Applying this concept to the operation of the dryer, many different items could be monitored by the counter, for instance, the number of revolutions of the motor that rotates the drum and fan. The counter circuit would monitor the actual run time of the dryer and after the run time reaches a pre-determined value, as determined by the manufacturer, a yellow indicator light on the control console would illuminate and instruct the user to "SERVICE DRYER SOON". At this point the user has been warned that the need for service is recommended, but the dryer remains operational. If the user follows the warning and contacts an authorized service person to disassemble and clean the dryer, the service person would follow the instructions in the Service Manual and reset the counter circuit back to zero. If the user were to ignore the warning, the yellow light would stay illuminated as a constant reminder. When the dryer reaches a pre-determined fault tolerance, 125% for instance, the counter circuit will illuminate a red indicator light on the control console and instruct the user to "SERVICE DRYER NOW". As an additional safety device, the counter circuit would also open and de-energize the heating element or gas burner, thereby removing the risk of fire, as the dryer will produce no heat. The lack of heat will force the user have an authorized service person disassemble the dryer so that the counter can be reset, allowing the servicer to clean and inspect the interior of the machine.

Indicator Light for Periodic Maintenance Reminder

WARNINGS & USER INSTRUCTIONS:

Dryer Warning Labels

The warning label is installed on the right side of the drum opening and is visible to the user when the door is open. The warning on the dryer does not warn against the fire hazards associated with lint collecting behind the drum at the heat source. This warning label only instructs to "exhaust the dryer to the outdoors", and to "prevent the accumulation of lint around the exhaust opening and in the surrounding area". The only other maintenance instructions regarding the exhausting of the appliance and prevention of lint accumulations within the appliance on the warning labels or visible on any of the component parts is to "Clean lint screen before or after each load." The Electrolux stand-alone dryers do not contain any warnings as to having the dryer serviced every 18 months, though their laundry centers, the combination washer/dryer unit, do have a warning label at the drum opening with those instructions. This

inconsistency demonstrates Electrolux's failure to provide consistent warning as to the maintenance methods they deem important as to the prevention of fires. Both labels are included below:

Warning Labels from Standalone Dryer (Left) & Laundry Center (Right)

Dryer User's Guide

Based on industry averages, the operational life expectance of a dryer is estimated to be at least ten years and possibly as long as 20 years. In addition, Electrolux requires routine maintenance on the part of the owner/operator. In their User's Guides, Electrolux recommends a qualified individual clean the interior of the dryer every 18 months. While there is some interpretation as to the definition of a "qualified individual", as it is not defined in the User's Guide, the user is instructed on basic maintenance such as cleaning the drum and emptying the lint filter between loads. The owner's manual also indicates that an authorized servicer must perform repairs and servicing.

Underwriters Laboratories, Inc. discusses User Maintenance Instructions under section 7.5.1 of UL 2158 Standard for Safety – Electric Clothes Dryers. It states "The User Maintenance Instructions shall include explicit instructions for all cleaning and servicing that is intended to be performed by the user, such as lubrication, adjustments, or removal of lint, dust or dirt." The labels and instructions for the Electrolux dryers do not discuss how the user should remove the dust and lint that collects behind the drum and in other inaccessible areas.

Excerpt from the Electrolux User's Guide

- The Safety Instructions found in the User's Guide reiterate the following:

> **! WARNING** Clean the lint screen before and after each load. The interior of the dryer, lint screen housing and exhaust duct should be cleaned approximately every 18 months by qualified service personnel. An excessive amount of lint build-up in these areas could result in inefficient drying and possible fire. See Care and Cleaning, pages 12-13.
>
> **! WARNING** Do not operate the dryer if the lint screen is blocked, damaged or missing. Fire hazard, overheating and damage to fabrics can occur. If your dryer has a drying rack, always replace the lint screen when finished using the drying rack.

! WARNING Keep the area around the exhaust opening and surrounding areas free from the accumulation of lint, dust and dirt.

! Failure to comply with these warnings could result in fire, explosion, serious bodily injury and/or damage to rubber or plastic parts of the dryer."

In regards to the requirement to have the dryer and its exhaust cleaned "approximately every 18-months", it is our opinion that this timeframe is based upon a numerical average time period determined by the manufacturer to be suitable for a user to have the appliance cleaned. Electrolux has not been able to tell us how they have come up with the "18 month" time period, and in Electrolux dryers manufactured for GE and "12 month" recommended cleaning timeframe is cited in the User's Guide. Due to the varying duty cycles of these appliances, as well as the variations between installations, this arbitrary timeframe is insufficient. A single user may dry one load of clothing a week, while a large family can easily dry multiple loads of clothing daily. Similarly, the amount of lint produced also correlates to the type of clothing and the textile properties of which the clothing is made. For example, a load of cotton towels produces a greater quantity of lint than a load of polyester shirts. The venting of the dryer, even if the dryer is vented according to manufacturer's instructions, will also affect the performance of the dryer, particularly the ventilation of lint particulate. A dryer that is located against an exterior wall and is vented directly to the exterior will be the most efficient, while a dryer located in the center of the building may meet the Maximum Length/Number of 90º Turns requirements set forth by the manufacturer, but will be less efficient at venting lint particulate. These factors all affect the statistical averages upon which the manufacturer based their timeframe for required cleanings.

A clothes dryer is one of the most common household appliances and the vast majority of users are familiar with the general operation of these devices, therefore it is foreseeable that the user may not read the manual. It is foreseeable that the user will continue to operate the dryer using only basic maintenance practices, such as cleaning the lint screen between loads and inspecting the exterior vent for blockages, until symptoms would arise that would indicate a need for service. The risk of fire that is tied to areas not viewable or serviceable by the average user

would continue to go unnoticed by the user in the meantime. It is foreseeable that the user will not refer to the instruction manual unless they are having problems with the dryer. It is just as foreseeable that the user will not hire a service technician to work on the dryer unless they are having an operational problem with the dryer. It is foreseeable that Electrolux dryers most likely will not be maintained according to manufacturer's instructions and that the vast majority of users will misinterpret, forget or ignore the 18 month cleaning requirement, particularly in view of the costs associated with having that period cleaning performed by a service technician.

Electrolux Service Manual

Furthermore, research was conducted into documents authored by Electrolux regarding the procedure for "qualified service personnel" to disassemble and clean the interior of the dryer, lint screen housing and exhaust duct. We obtained a copy of the **Electrolux Service Manual** for **27" Dryers, Gas and Electric Models** (September, 2002). This was the only document published by Electrolux, which covered the service of the dryers constructed using the design and components similar to and including the subject dryer.

The service manual contained the following warning:

- "ATTENTION!!!"
- "This service manual is intended for use by persons having electrical and mechanical training and a level of knowledge of these subjects generally considered being acceptable in the appliance repair trade."

As outlined in the above statement, this Service Manual is not meant for the average end user. However, a review of the technical document meant for an actual service person did not reveal any information relative to the prevention of fires through routine maintenance procedures.

The service manual contained multiple sections regarding the operation, troubleshooting and disassembly of Electrolux dryers. This is a summary of the sections contained within the service manual:

1. **SAFE SERVICING PRACTICES** – Describes the safety practices to be employed when servicing any appliance
2. **QUICK REFERENCE SHEET** – Describes the nameplate and tech sheet locations and serial number breakdown
3. **SAMPLE WIRING DIAGRAMS** – Contains sample wiring diagrams for electric and gas models, with and without electronic moisture sensor controls
4. **SECTION A – OPERATING INSTRUCTIONS** – Contains a copy of the standard operating instruction sheet supplied with all Electrolux dryers
5. **SECTION B – OWNERS GUIDE** – Contains a copy of the Owners Guide supplied with all Electrolux dryers
6. **SECTION C – INSTALLATION INSTRUCTIONS GAS & ELECTRIC DRYER** – Contains a copy of the Installation Instructions supplied with all Electrolux dryers, for both gas and electric dryers
7. **SECTION D – HOW THE COMPONENTS WORK** – Contains a description of the basic components of the dryers and principals through which they are employed during the drying process
8. **SECTION E –** There is no SECTION E contained in the Service Manual, nor is there a listing for SECTION E in the Table Of Contents at the front of the manual
9. **SECTION F – TROUBLESHOOTING FLOW CHARTS** – Contains numerous flow charts to assist in the diagnosis of a problem and to apply the recommended corrective action(s)
10. **SECTION G – TEARDOWN** – Contains a step by step guide (with corresponding photos) to the complete disassembly of the dryer and its components

A review of the Service Manual revealed NO specific instructions as to the required 18-month cleaning within the Owner's Guide. There was no description of how to clean the interior of the dryer, the lint screen housing or the exhaust duct. There was no discussion as to the evaluation of the appliance for excessive lint buildup, and no specific description of the area behind the drum near the heat source, the plastic trap duct and blower assembly or any other areas that should be cleaned every 18 months.

Research of Maintenance by Authorized Servicers

As part of a further evaluation as to the frequency of regularly scheduled maintenance of Frigidaire dryers, we attempted to obtain service quotes from local appliance service companies. We accessed the Electrolux appliance website (www.electroluxappliances.com), and using their "Service Locator" searched for recommended local service companies. We entered the zip code for our office in Uxbridge, Massachusetts, as well as the neighboring zip code for North Uxbridge, but no service providers were listed for the surrounding area. We then called the telephone number listed on the web page, which directed us to call an alternate number after working through the various option menus. Only then were we provided with recommended service companies.

We conducted a survey of three of the recommended service companies. The first was one of the largest appliance retailers in the local metropolitan area. When we spoke to their Customer Service Department to request a cleaning of a Frigidaire gas fired dryer, the operator stated that they did not normally offer that service. We further explained the requirements of the regular maintenance listed in the Electrolux User's Guide. We were then provided with basic instructions to inspect and clean the lint from the exhaust hood on the exterior of our building. Finally, after explaining that the owner's manual required that the interior of the dryer needed to be cleaned, we were then quoted a one-time cost of $109.00 for a service technician to respond to the location and diagnose the problem, and an additional $27.25 for every 15 minutes of additional labor. Contacting two other smaller appliance repair companies yielded similar findings, with questions regarding the need for service prior to rate quotes from the second company of $94.00 for the site visit and first 30 minutes of service and $20.00 for each additional 15 minutes of labor, with an estimate of 45 minutes of labor. The third company quoted a flat rate of $85.00 for the cleaning of the dryer and exhaust system. Based upon these figures, it is estimated that a user who follows the maintenance schedule would incur a cost of approximately 20-40% of the original purchase price of their appliance every 18-months.

In our prior discussion regarding the survey of the local service providers, not one of the representatives we interviewed was overly specific about the steps they would take to clean the

dryer and related components. One appliance sales company stated they did not receive any specific instruction manuals or reference materials as to the time period or specific requirements regarding the 18-month cleaning schedule. Only one of them stated that they would go as far as removing the drum from the dryer and clean the area behind the drum. Accordingly, even if a user were to hire a service provider to clean their dyer as recommended by the User's Guide, it is foreseeable that the servicer may fail to remove lint from the most critical, yet not easily accessible, locations in the dryer, such as the area behind the drum where the heat source is located.

In a recent Electrolux clothes dryer fire, the Wright Group was provided a copy of the deposition of a Service Manager for Abt. Abt is large company that is an authorized Electrolux service provider with over 1500 employees. The Service Manager testified that Abt did not provide the 18-mouth service to any of its customers until the last year. Abt has no instructions from Electrolux on how to clean the interior of the cabinet and now only offers a vent cleaning service. The customers of Abt can now have their vents cleaned but Abt will not complete the cleaning of the interior dryer cabinet service. The Abt Service Manager testified that has never personally experienced a situation where a user has contacted Abt and requested the 18-month service recommended by Electrolux in their User Guide.

STANDARDS REVIEW:

American National Standard Institute, ANSI Z21.5.1/ Underwriters Laboratory, UL 2158

This writer has reviewed the ANSI Standard Z21.5.1 regarding gas clothes dryers and has noted no testing of any units that have already been in service in the users' homes or simulated aged units. They do not discuss the fire containment issues such as the use of the latch required to keep the cabinet door closed or the sealing gasket used to form the seal between the dryer door and the front of the cabinet. The only reference to the latch is that it must pass the door and catch test. The test simply consists of a direct pull on the handle or push on the interior door of the door shall not exceed 18 pounds to open the door.

In reviewing the ANSI Standards for gas dryers and UL Standards for electric dryers there is currently no requirements in the Voluntary Standards, to prevent accumulation of lint within a dryer, whether in proximity to the heat source or at any other locations within the dryer. A review of the standards also indicates that there is no information regarding the accumulation of lint within a dryer and the prevention of that accumulated lint from ignition.

Just because an Electrolux dryer is UL stamped does not mean it is necessarily safe or passes the standard. UL states, "A product, which complies with the text of the standard will not necessarily be judged to comply with the standard if, when examined and tested, it is found to have other features, which impair the level of safety contemplated by these requirements".

Electrolux's dryers do not comply with the UL standard in regards to warnings or instructions. UL 2158, Section 7.1.1.3 states: "A cautionary marking intended to instruct the operator shall be legible and visible to the operator during normal operation of the appliance. A marking giving servicing instructions shall be legible and visible when such servicing is being performed." Electrolux, in its User's Guide, instructs that the dryer and exhaust be serviced approximately every 18 months to prevent fires. On the freestanding dryers, there are no cautionary marking at all that instruct the user to have the unit professionally serviced approximately every 18 months, only an instruction to regularly inspect the exterior vent and keep it clear of obstructions. Furthermore, there are no markings on either the freestanding dryer or the Laundry Center that instructs the operator how to remove the lint from hazard areas or from where lint should be removed. Electrolux's Product Safety Engineer for its Laundry Division, Carl King, and the corporation's liaison with UL, admitted in testimony that these dryers fail to comply with UL 2158, Section 7.1.1.3

As previously discussed in the User's Guide section, UL discusses User Maintenance Instructions under section 7.5.1, "The User Maintenance Instructions shall include explicit instructions for all cleaning and servicing that is intended to be performed by the user, such as lubrication, adjustments, or removal of lint, dust, or dirt". The User's Guides for the Electrolux dryers do not discuss how the user should remove the dust and lint, which collects behind the drum and in other inaccessible areas.

UL has a blockage of lint screen and exhaust test listed under section 19.5. This test discusses the operation of the dryer with a lint screen blocked at 75% and 100% as well as an exhaust that is blocked at 75% and 100%. The appliance tested shall have no:

A. Emission of flame or molten metal
B. Glowing or flaming of combustible material upon which the appliance may be placed or that may be in the proximity to the appliance as installed or
C. Indication of flame or glowing embers in the load of clothes either before or after the access door is opened.

This test is completed on a brand new dryer and not an aged dryer. When the exhaust is restricted, the temperature behind the drum is substantially raised. The higher temperatures behind the drum, at the heating element, can ignite lint that collects in close proximity to the heating element in dryers that have been in use for a period of time. The UL testing does not account for lint that collects in the area of the heat source in the Electrolux designed dryer, a fuel that is not present when brand new dryers are tested to undergo UL certification.

CONSUMER PRODUCTS SAFETY COMMISSION:

Overview of Dryer Related Documents

The Consumer Products Safety Commission has published several documents with regards to lint collection and dryers and has concluded:

- Lint accumulates within all designs of dryers
- Lint can collect in locations near heat sources
- Lint is combustible
- Accumulated lint poses a fire hazard
- Once ignited, burning lint can then ignite the laundry load or lint elsewhere within the dryer

- There are no requirements in the current Voluntary Standards, UL and ANSI, to prevent lint accumulation within a dryer or to prevent ignition of lint.

May 2003 Report on Electric Clothes Dryers and Lint Ignition Characteristics

In the Executive summary of its May 2003 "Final Report on Electric Clothes Dryers and Lint Ignition Characteristics", the CPSC expressly states:

- Lint begins to accumulate inside of the dryer chassis upon first use. Lint Accumulates on the dryer's components, including the heater and the dryer floor. This accumulation occurs even when the dryer's lint screen has been cleaned after each usage, and the dryer is properly exhausted.

Regarding the potential for ignition of lint that has accumulated within a dryer, CPSC expressly states in the May 2003 report:

- Lint accumulating near the heater intake can ignite before the high-limit thermostat switches the heater element off.
- Lint ingested by the heater and embers expelled from the heater outlet can easily ignite additional lint or fabric in the air stream, resulting in additional embers in the dryer system and exhaust vent.

Contrary to the contentions of Electrolux, notwithstanding a dryer's compliance with ANSI and UL standards, the Wright Group agrees with the CPSC's findings that lint can and does accumulate and ignite within the cabinet of a dryer from the time of its very first use. This occurs despite regular cleaning of the lint filter and proper exhaust of the dryer.

Consumer Opinion Survey on Clothes Dryer Installation and Maintenance

The Consumer Product Safety Commission conducted a Consumer Opinion Survey, # 3, and issued a report on their findings in September of 2010. A review of that documentation indicates that over 64% of the customers surveyed used flexible accordion-type duct for all or at least a portion of their dryer vent. The survey also revealed that only 38% of the respondents ever clean

their ducts. Of 358 respondents, only 71 had the interior of the dryer cabinet cleaned. Of those 71 persons, 8 reported that the dryer had only been cleaned because of another service reason. In total, only 20% of respondents that participated in the survey performed all of the tasks recommended by residential clothes dryer manufacturers through the Association of Home Appliance Manufacturer's dryer maintenance checklist. The report concludes that the survey supports that most users will only complete those maintenance tasks that are easiest to perform on their own and that do not cost them a monetary expense through a professional service company. The CPSC report also clearly indicates that the results were based on data collected from a convenience sample, not a random sample. Therefore, "*because voluntary registration via the CPSC website is the only method by which consumers can participate in the survey, the staff believes that this respondent population is more likely to show an interest in product safety and to be more aware of safety issues than the general public. Unsafe behaviors or low hazard perceptions among this population would most likely point to problems that would be even more prevalent among the general consumer population.*"

The document outlines numerous other statistics and supports our opinions that it is foreseeable that the average user is unaware of the fire hazards associated with residential clothes dryers in regards to their installation and maintenance. This type of consumer survey information could have been obtained by Electrolux to better assist in the design of a dryer that relies more on the principals of Safety Engineering, in that many of the associated hazards relating to problems they fault the user for can be eliminated or significantly reduced through engineering.

The survey completed by the Consumer Product Safety Commission, is consistent with the Electrolux Service Bulletin dated November 2000, which indicates most people use flexible foil ductwork in their dryer installation. It is well known to Electrolux and other manufacturers in the industry that flexible ductwork is commonly and consistently used in the majority of dryer installations. This is because flexible ducts are installed by professionals or sold by retailers and supplied to homeowners that install the dryers themselves.

CPSC Evaluation of Using Indicators to Inform Consumers of Clothes Dryer Status

In a report issued by the CPSC in June 2011, the CPSC used their September 2010 study as a basis to establish a recommendation that safety devices in clothes dryers could lead to better maintenance practices by the user to assist in the reduction of lint-related fires in clothes dryers. The following are the conclusions as reported in the June 2011 CPSC report:

> *"Consumers report that they usually clean their clothes dryer lint filters; however, they also report that they typically do not clean the ducting or inside the dryer cabinet. Failure to clean ducts and airways is among the leading factors associated with clothes dryer fires. Lint can accumulate inside a dryer even when a dryers lint screen has been cleaned after each use and the dryer is properly exhausted. Lint accumulating inside the dryer cabinet and in contact with the heater can potentially lead to a fire.*
>
> *As seen in consumer related incidents, a dryer can be operating in an unfavorable mode for an extended period of time until the situation escalates into a more hazardous scenario. Clothes dryers commonly do not include any form of operating status indicators. Indicators that remind consumers of maintenance tasks or warn that the clothes dryer is not operating normally, could offer customers valuable information that might improve clothes dryer safety.*
>
> *Maintenance indicators could be used to remind consumers to clean inside the dryer chassis and dryer duct. Counting dryer loads is one easy method that can be translated to an indicator to remind consumers when a task needs to be performed – check and clean the exhaust exit, exhaust duct and inside the dryer cabinet. The specific number of times that a dryer can run before a check or cleaning task needs to be performed would be manufacturer and dryer design specific.*
>
> *An 'abnormal operation' indicator could provide customers with information about a potential hazardous condition. Normally, clothes that do not dry may be the only indication to a customer that a dryer is not operating correctly. The dryer can enter into*

a high limit cycling mode from a number of conditions, such as an overloaded dryer, a blocked exhaust duct, or a blocked lint screen. Feedback on the status of the high limit thermostat would be a valuable indicator that service needs to be performed on the dryer system.

Using indicators to tell the customer that maintenance and service are required on the clothes dryer can potentially reduce the number of fire related incidents involving clothes dryers."

The Wright Group agrees with this CPSC documentation and the use of indicators to inform customers regarding the status of their dryer. As previously discussed, the use of written warnings and/or instructions is the least preferable method to protect against a hazard. The use of engineered active warning device would be the preferable method to warn the user of abnormal operating conditions and assist in the prevention of lint-related fires in any clothes dryer, and particularly in the subject Ball Hitch design employed by Electrolux where the design allows for the accumulation of lint in proximity to the heat source behind the drum where it cannot be observed or removed by the average user.

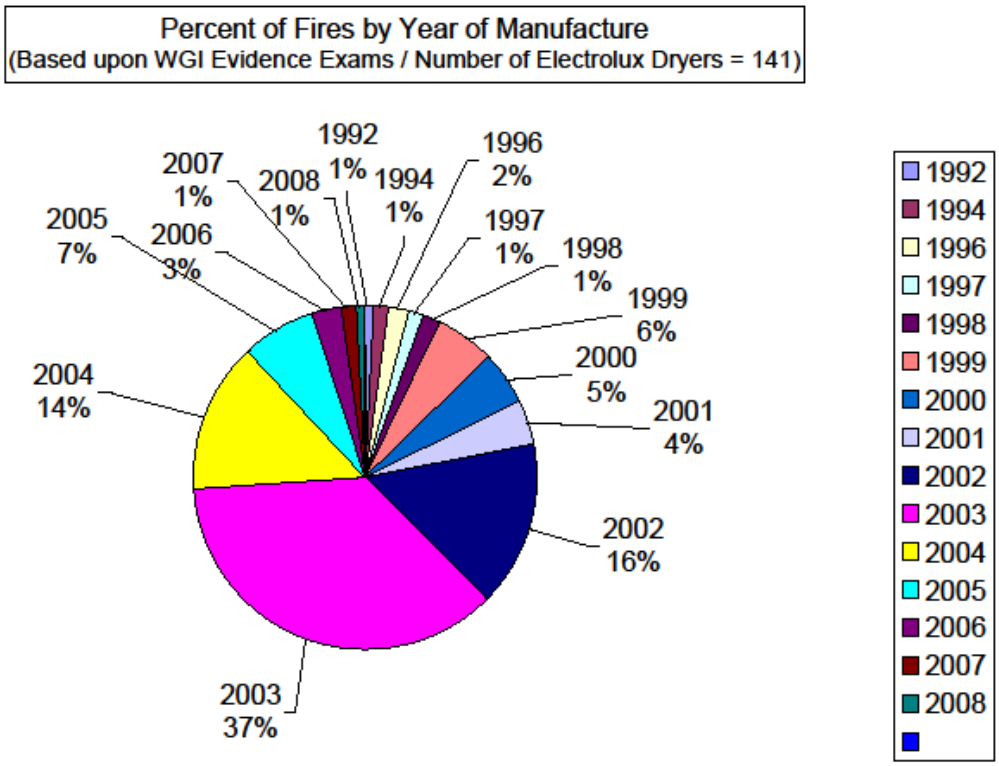
UNIVERSITY OF KENTUCKY REPORT:

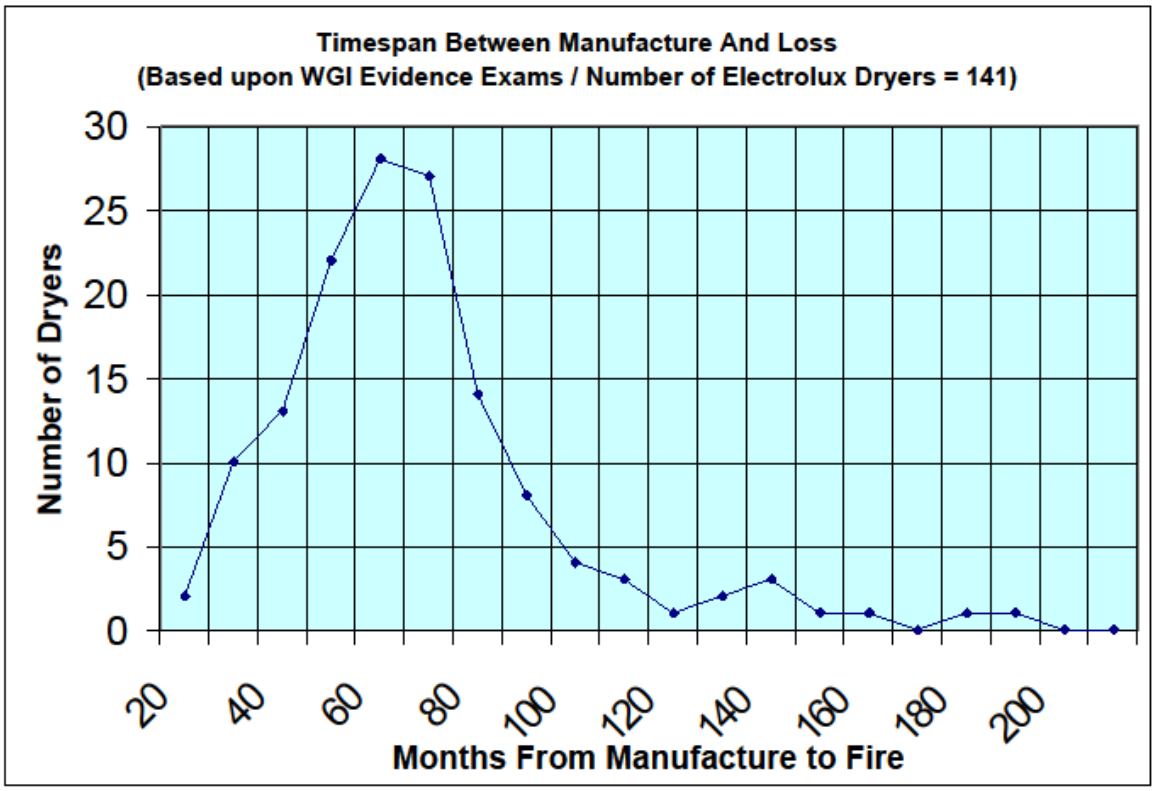
The University of Kentucky Report, dated August 1992, was the evaluation of spontaneous combustion of laundered fabrics soiled with vegetable oil. The purpose of this evaluation was to examine the potential for spontaneous combustion of vegetable oil soaked terry cloth towels after simulated consumer laundry conditions. A review of the entire document indicates that there were no resulting fires from clothes that were tumbling in a dryer and the clothing did not reach any abnormal temperatures. Based on the results of this evaluation, vegetable oil saturated towels laundered in extreme conditions i.e. cold water wash will retain up to 48.3% W/W oil after laundering. But for all of the oil/fabric combinations evaluated during this investigation, spontaneous combustion did not occur in the clothes dryer. Nor did spontaneous combustion occur in the storage of a load that had been dried in a clothes dryer and stored in a laundry basket. Only after the load was removed and heated in an oven at 200°F did any of the laundry

items achieve spontaneous ignition. The only other condition in which spontaneous combustion occurred was when sunflower and soybean oil soaked towels were washed and lined dried then heated in an oven. The corn oil soaked towels did not combust under these same conditions.

STATISTICAL DATA:

Statistical data was also compiled using these burned Electrolux dryers. For a group of 141 Electrolux dryers involved in fires (both gas and electric models), the following charts outline the percentage of fires based upon the year the dryer was manufactured and the time span, in months, between the date of manufacture and the date of the fire. The greatest frequency of fires occurred in a general range from 3 to 6.5 years, with the highest number of fires occurring approximately 5 years after the date the dryer was manufactured. The greatest percentage of dryers based upon the year of manufacture occurred after Electrolux altered the felt front seal. Similar statistical analysis has been conducted by some of our peers, including Fire Findings Investigations and the Traveler's Insurance Laboratories. Their findings were substantially similar to the Wright Group's statistical analysis.





Testing

The Wright Group has conducted a large amount of testing on the Electrolux/GE designed dryers. Much of the original testing involving the principles shared between the General Electric and Electrolux dryers has been conducted over the last 15 years. Due to the increased amount of Electrolux dryers the Wright Group has been exposed to over the past several years, some of the GE testing performed by the Wright Group was reduplicated on Electrolux dryers. Other testing has been added to address specific fire related issues with the Electrolux dryers, while other testing has been conducted in response to Electrolux's experts' opinions and testing. Some of this testing has been performed in conjunction with our peers, or has been reviewed by our peers. Similar testing conducted separately by our peers have produced similar results and are the basis for our opinions regarding fire cause related to the subject dryer, analysis of the inherent fire hazards associated with the Electrolux design, and opinions regarding ignition, growth and spread of fire within and out of the subject Electrolux dryers.

All of the testing conducted by the Wright Group has been thoroughly documented using video, photographs, measurements, thermocouples, volumeters, etc. The data has been analyzed and has been the basis through which our initial hypotheses were validated. All of the opinions of Wright Group, Inc., in regards to the cause of the fires in the dryers manufactured by Electrolux, are a result of the thorough understanding of these appliances through baseline testing and actual fire testing.

The testing conducted by Wright Group that is specific to Electrolux includes:

- Fire Propagation and Spread Testing – September 2007
    - Conducted to validate the transfer of heat energy from the first fuel to the secondary fuels within the appliance and then to the spread fuels outside of the dryer.
- Gas Dryer Flame Height and Lint Ignition Testing – September 2008 **(Appendix III)**
    - Conducted to simulate the effect of lint accumulating on the burner and the changes that occur in the premix ratio of fuel to air in a normally operating burner compared to that of a burner with a partly or fully blocked air intake.
- Baseline Temperature Testing and Airflow Testing – November 2008
    - These tests were conducted under normal operation to document the operational characteristics of these dryers. Testing was conducted using various restrictions of the ventilation components, to simulate various amounts of restrictions or even complete blockage. The operational thermostats and high limit safety devices were tested using the same variations of restriction. Comparative analysis was performed to test the amount of restriction an actual load places on the volume of air output from the dryer. Thermocouple data was collected to show the variation in temperature at various points throughout the dryer, in unaltered dryers and through the use of simulated restriction percentages.
- Electric Dryer Lint Ignition and Fire Growth Testing – November/December 2008
    - Lint ignition scenarios were tested to validate the current opinions regarding the ignition scenarios. Fire testing was conducted regarding the flammability of components as well as fire containment issues.

- Gas Dryer Alternative Design Testing – December 2009 **(Appendix V)**
    - The Wright's Group's design alternative using a metal guard was installed on a gas dryer and tested. The purpose of the efficiency testing was to verify that the modification did not subtract from the efficiency of the dryer. Multiple time/temperature tests were conducted to verify that it took the same amount of time for an identical load to be dried in an unmodified dryer as it took in the alternative design
- Dryer Exhaust Testing – July 2010 **(Appendix IV)**
    - Conducted to evaluate various external vent duct installations. A manometer was used to measure the exhaust backpressure at the rear of the dryer, as per Electrolux's Installation Instructions. Various configurations of exhaust ducting were applied to both freestanding dryers and laundry centers and measurements were taken. All three types of commonly found exhaust ducts were used: rigid, semi-rigid and flexible foil. The various exhaust configurations included those recommended in the table under the exhaust section of the Installation Instructions. Once the baseline measurements were obtained, the length and number of elbows was increased incrementally until the maximum allowable backpressure of 0.75" W.C. was obtained.
- Electric Dryer Alternative Design Testing – July 2010 **(Appendix V)**
    - The Wright's Group's design alternative using a metal guard was installed on an electric dryer and tested. This design alternative also relocated the heating element from directly behind the drum to the base of the cabinet. The purpose of the efficiency testing was to verify that the modification did not subtract from the efficiency of the dryer. Multiple time/temperature tests were conducted to verify that it took the same amount of time for an identical load to be dried in an unmodified dryer as it took in the alternative design
- Vertical Heat Duct/Heater Pan Temperature Test – August 2011 **(Appendix VI)**
    - Testing was conducted on an Electrolux ball-hitch freestanding gas dryer to document the temperatures attained behind the drum where the vertical heat duct carrying the hot air from the burner tube interested with the heater pan. Two tests were conducted using the same dryer, set to High Heat, with an empty lint screen

and no load. The only variable between these tests were that one test was conducted with no exhaust attached to the dryer and in the other test the dryer was equipped with an exhaust that was set to the maximum allowable exhaust vent restriction of 0.75" H_2O. These exhaust variables were used to achieve the most efficient and least efficient exhausts allowed by the Installation Instructions. The maximum temperatures recorded at the right edge of the vertical heat duct where it intersected the heater pan were 800°F with no vent and 1100°F on the vent with the maximum allowable restriction. Both temperatures exceed the auto ignition temperatures of cotton based lint and support our opinion that lint collected in the heater pan can be auto ignited by heat produced by the burner flame in a properly vented dryer. This data coincides with our September 2008 Lint Ignition test in which we were able to ignite lint targets at this same location in gas ball-hitch dryers.

- Lint Accumulation Testing – May - June 2011 & April-May 2012 **(Appendix VII)**
    - Testing similar to ESI/Electrolux's lint accumulation test on freestanding gas/electric and Laundry Center gas/electric was conducted. The ESI/Electrolux tests used brand new, never used appliances and an ASTM standard test load. The groups of dryers they used were tested using a "properly vented" and a "restricted" exhaust, however, the "properly vented" exhaust was well vented with approximately 0.52 inches of water column backpressure restriction while the "restricted" exhaust was tested at 0.90 inches of water column backpressure. Electrolux's installation instructions allow up to 0.75 inches of water column backpressure in any installation. The Wright Group's testing began in May and June 2011 with a test on a freestanding gas dryer with an exhaust restricted to approximately 0.74 inches of water column, on a dryer in used condition (See Photos 8-17 below), drying loads of 10 brand new cotton bath towels for 20 cycles total and obtained substantially different results, including a much heavier accumulations of lint and a lint fire between 10 and 20 loads. This test was followed by testing on additional dryers using the same protocol, including an unused Electrolux freestanding gas dryer, with the baffle removed, and the seal between the blower housing and exhaust tube taped to prevent any pressurized

release of lint from that joint. The results of this test revealed substantial accumulations of lint in the heater pan after only 20 loads of towels. Testing was performed on another new Electrolux freestanding gas, with the baffle removed, but with no foil tape sealing any internal components (See Photos 1-7 below). This test was done to substantiate that the foil tape did not affect the accumulation of lint within the dryer. The test results revealed nearly identical test results to the previous test, with no increase in the amount of lint released into the cabinet.

Testing using the same protocol was conducted on a used, freestanding, electric clothes dryer manufactured by Maytag and employing the bulkhead design in June 2011 (See Photos 18-22 below). The results of this test were that absolutely no lint accumulated within the heat duct that carried heated air into the rear of the drum from the heating element. And in May 2012, this testing was conducted on brand new gas and electric models of the Frigidaire Affinity bulkhead design of clothes dryers manufactured in Juarez, Mexico. The results were the same as with the Maytag design; no lint collected in the air stream between the heat source and the drum inlet at the rear of the drum.

This protocol was used in testing the RONCO 3 gas dryer prototype to evaluate lint ignition in an Electrolux ball-hitch modified with a guard to prevent lint from coming into contact with the hot gasses and flames produced by the gas burner. During this testing, lint collected in the heater pan as it had in the unmodified Electrolux ball-hitch dryers. Due to the fastening materials used in the construction and installation of the prototype guard, more lint accumulated than would be expected in the heater pan. However, no lint was observed within the extension of the vertical heat duct and the thermal break in the guard that separated the lint in the heater pan from entering the vertical heat duct prevented any ignition of the lint that collected within the modified dryer prototype. This testing confirmed our hypothesis that a guard could be added to the existing design to prevent the ignition of lint by the heat sources in these dryer.

Based upon this testing, it has been demonstrated that the ball-hitch design, used by Electrolux in their dryers, operated without a baffle and with an exhaust system back pressure of less than 0.75 inches of water column (specified in Electrolux's Installation Instructions as "acceptable") accumulate significant amounts of lint in between the heat source and the drum after only twenty loads of ten bath towels were washed and dried. The used Electrolux ball-hitch dryer collected even more lint, and a lint ignition fire occurred during the test. The RONCO 3 alternative still collected lint in the heater pan, but the guard prevented the lint from entering the heat duct and igniting. In contrast, the bulkhead design used by Whirlpool, Maytag, LG, Samsung and now Electrolux, was tested using the same parameters did not accumulate any lint in the path of airflow between the heat source and the drum.

Photo 1: New Electrolux Dryer - Heater Pan before Testing

Photo 2: New Electrolux Dryer - Heater Pan before Testing

Photo 3: New Electrolux Dryer – Rear of Drum before Testing

Photo 4: New Electrolux Dryer – Cabinet and Heater Pan after Testing

Photo 5: New Electrolux Dryer - Heater Pan after Testing

Photo 6: New Electrolux Dryer – Lint in Heater Pan after Testing

Photo 7: New Electrolux Dryer – Rear of Drum after Testing

Photo 8: Used Electrolux Dryer - Cabinet before Testing

Photo 9: Used Electrolux Dryer – Heater Pan before Testing

Photo 10: Used Electrolux Dryer – Lint in Heater Pan before Testing

Photo 11: Used Electrolux Dryer – Rear of Drum before Testing

Photo 12: Used Electrolux Dryer – Lint on Rear of Drum before Testing

Photo 13: Used Electrolux Dryer – Heater Pan Testing

Photo 14: Used Electrolux Dryer – Burned and Fresh Lint in Heater Pan after Testing

Photo 15: Used Electrolux Dryer – Layers of Colored and Charred Lint after Testing

Photo 16: Used Electrolux Dryer – Rear of Drum after Testing

Photo 17: Used Electrolux Dryer – Burned Lint on Rear of Drum after Testing

Photo 18: Used Maytag Dryer - Cabinet before Testing

Photo 19: Used Maytag Dryer – Heater and Heat Duct before Testing

Photo 20: Used Maytag Dryer – Interior of Heat Duct before Testing

Photo 21: Used Maytag Dryer - Cabinet and Heater after Testing

Photo 22: Used Maytag Dryer – Interior of Heat Duct after Testing

- Component Burn Testing – October 2013
    - Testing was conducted on dryer parts to evaluate their burn characteristics when exposed to flame. The parts chosen were the major component parts used in Electrolux dryers located at the lower right front corner including the air duct (otherwise referred to as the trap duct), the blower housing and the fan impeller which were all manufactured from plastics. Since Electrolux has manufactured these plastic parts from plastics with varying levels of fire retardants, specimen parts from different dryers and vintages were used. The purpose of this test was to determine the burning characteristics and ability to self-extinguish between these parts, based upon their configuration and the type of plastic they are constructed of. Testing was also conducted on similar parts used in a Whirlpool clothes dryer, as a comparison. All of the testing was documented with photographs and video.

      Testing was conducted on the air duct (trap duct), blower housing and fan impeller from the most common models of Electrolux Ball-Hitch dryers, i.e.

Frigidaire freestanding clothes dryers manufactured from approximately 1996 through 2011, (Alliance platform) which were all manufactured from HB rated plastics with no fire retardants. This allowed all of these components to be easily ignited with a short duration flame (30 seconds) when exposed to a Bunsen burner. Once ignited and with the flame removed, these HB plastic components became fully involved in fire. The burning plastics dripped flaming molten plastic and the pooling plastic material sustained a surface flame that spread outward from each component. Even with the flame removed, the combustion process continued until the structure of each component was consumed. In some cases, the majority of HB rated plastic was consumed and all that remained was a small pool of remaining material. These HB rated components burned continuously for long durations; the HB air duct burned for approximately 65 minutes and the HB blower assembly burned for approximately 30 minutes.

Testing was conducted on an air duct (trap duct) from a GE Ball-Hitch dryer, manufactured by Electrolux to comply with GE's internal fire drum-fire containment test, the GE SEE test. The 5V plastic air duct ignited when exposed to flame but self-extinguished when the flame was removed. Only by continuously exposing the 5V air duct to continuous flame in one spot did the combustion process continue. However, when all of the HB plastic materials exposed to the area of the flame were consumed, the 5V material self-extinguished and the majority of the fire retardant 5V plastic material of the air duct survived the testing. It is also important to note that there was no flaming molten plastic formed during this test of the 5V air duct. The 5V air duct only burned for approximately 4 minutes during constant exposure to the outside flame source before the material exposed to the flame was consumed and the component self-extinguished.

Testing was conducted on a blower assembly from an Affinity 7.0 Cu. Ft. Bulkhead dryer, manufactured by Electrolux to comply with the drum-fire and base-fire containment tests outline in the UL 2158 Electric Clothes Dryer

standard, which came into effect in March 2013. In order to meet the minimum standard of the new fire containment testing, Electrolux used tape to seal openings in the base of the cabinet, used expanding fire sealant between the cabinet and the front panel at the lower right front corner and changed some of the internal components to fire retardant 5V plastics, including the air duct and blower housing. However, since the fan impeller remained manufactured from non-fire retardant HB plastic, we tested the blower assembly. The 5V plastic blower housing ignited when exposed to 30 seconds of flame from the Bunsen burner and self-extinguished when the flame was removed. However, when exposed to flame for 60 seconds, the 5V material had been partly consumed and the HB plastic fan impeller inside of the blower housing was ignited. When the flame was removed, the 5V plastic exposed to the Bunsen burner flame self-extinguished but the HB plastic fan continued to burn without any additional external heat source. The continuously combusting HB fan caused the 5V plastic surrounding the fan to burn while it was subjected to the energy of the burning HB plastic. However, when all of the plastic materials in the area of the fan at the right side of the blower assembly were consumed, the 5V materials at the left side of the blower housing self-extinguished and some of the 5V plastic material of the air duct survived the testing. The blower assembly burned for approximately 122 minutes, the majority of which was due to the HB fan burning encapsulated within the 5V blower housing.

A steel air duct from a Whirlpool Bulkhead dryer (recommended alternative) was tested using the same methodology and set-up. There was no ignition of the steel. The plastic fan impeller from a Whirlpool Bulkhead dryer was also tested on an individual basis. The plastic material of this fan displayed more resistance to ignition by the flame in the Bunsen burner testing than the Electrolux HB fan impeller did. Based upon our observations, the Whirlpool fan may have been made out of V-1 or V-2 plastics, which have some fire retardant properties. However, in this component's form, combustion continued without additional flame necessary until the plastic was mostly consumed after approximately 31

minutes. In its intended configuration, surrounded by a steel blower and air duct assembly, this fan would not be easily ignited and if it were, the surrounding components would add an additional layer of fire containment.

Based upon the results of this testing, our opinions that the use of alternative materials would be effective in containing the fire to the cabinet in most conditions, particularly in the Electrolux Ball-Hitch dryer fires where the fire transfers to the lint collected in and around the air duct and blower assembly located at the right front corner of the Ball-Hitch dryer. Had Electrolux used steel components, they would have been most effective in containing fires within these dryers and would not have added additional fuels to the fire. Though less effective, had they manufactured the major plastic components at the right front corner of their Ball-Hitch dryers, including the air duct, blower housing and fan impeller out of 5V fire retardant plastics, their design would have improved. In some circumstances, small fires would not have the energy to ignite the 5V plastics. In other cases where there is enough heat to ignite the 5V materials, the fuel load would be limited by 5V's ability to self-extinguish. Another substantial benefit of 5V plastic over HB plastic was the elimination of HB's characteristic of flaming molten material, which increases the probability of flaming material escaping the cabinet to ignite surrounding combustibles.

- Fire Containment Testing – October 2013
    - The purpose of this test was to test Electrolux's Ball-Hitch dryer, as produced in its common configuration to determine if it would pass a base-fire containment test. Testing was conducted on a common model Electrolux Ball-Hitch dryer, i.e. Frigidaire freestanding clothes dryer (Alliance platform), with all plastic components at the right front corner manufactured from HB rated plastics with no fire retardants. Due to the fact that the dryer used for testing, Model FDE216RES1, Serial XD85175981 was manufactured in 1998 and was equipped with a blower housing with a steel face plate, the blower housing was changed to an all HB plastic version. This test dryer was in used condition, but all lint was cleaned from the dryer. This test was conducted with the dryer off, not connected

to any electrical supply and with no load in the drum. This test was documented with photographs and video, with videography recorded via two external cameras and two cameras within the base of the cabinet.

Per the UL 2159 Electric Clothes Dryer standard's base-fire containment test protocol, 8 layers of cheesecloth was inserted within the base of the dryer cabinet, in the immediate area surrounding the front and sides of the blower assembly and below the trap duct. A minimal footprint of cheesecloth was used within the cabinet to limit that amount of combustible material added to the dryer. A 1" wide trailer of 8 layers of cheesecloth was laid in the cabinet to transmit the open flame, applied by butane lighter at the left rear corner of the cabinet, to the cheesecloth at the right front corner. The dryer was wrapped in a single layer of cheesecloth, including a layer over the non-combustible the dryer was situated on for the test.

Upon ignition with a butane lighter, flame traversed the base of the cabinet via the cheesecloth trailer, in turn, igniting the cheesecloth at the right front corner, within approximately 2 minutes. The fire ignited the plastic materials in the area at the right front corner where the plastic trap duct mated to the plastic blower housing approximately 3 minutes later. Once the HB rated plastic was ignited, the plastic did not self-extinguish and the flames grew. After approximately 3 additional minutes, the flaming molten plastic escaped through the bottom seam between the front panel and cabinet, immediately igniting the cheesecloth covering the appliance. Per the UL 2158 test standard, the ignition or any visible heat damage to the outer cheesecloth covering constitutes a failure of UL's fire containment testing. During our test, the dryer was allowed to burn for several more minutes before being extinguished, during which time the commonly observed fire patterns formed at the right front corner from the non-fire retardant HB plastic components in that area continuing to burn.

The results of the test confirmed our opinions that the subject design of Electrolux Ball-Hitch dryers fails to contain a fire originating in the base of the dryer for any reason. A small fire in the base of the cabinet that originates from any fire cause, with a minimum amount of easily ignitable lint acting as the catalyst, will ignite the plastics in the base of the cabinet. The test also revealed that the inappropriate use of HB plastics with no fire retardants assisted in the spread of fire outside of the cabinet, as the flaming molten plastic escaped through the seam and ignited the outer cheesecloth.

Review of Opinions with Other Experts

The Wright Group has consulted with other fire origin and cause experts across the country in many of the numerous Electrolux dryer fire cases in which we have been involved. The Wright Group's opinions as to ignition scenarios, lint accumulation, design defects and warnings are substantially similar to independent opinions offered by other experts. Electrolux's own experts, including those from Pyrtech, Inc., have offered their expert opinions that the ignition of lint occurs behind the drum and spreads to the load in the drum and/or lint and plastic materials in the trap duct. We have compared our testing, data and opinions with Fire Findings Investigations, Inc. and Traveler's Insurance Laboratories, two independent labs that have investigated dryer fires in hundreds of Electrolux dryers and found that their experts concur with our opinions.

Fire Findings Investigations Report for a Gas-Fired Electrolux Dryer, Dated February 17, 2011:

In the Kelly and Rodney Slabach/State Farm Insurance Vs. Electrolux Home Products case, U.S. District Court – Northern District of Indiana, Case #: 3:08-cv-00436-WCL-CAN, Jack Sanderson of Fire Findings Investigations conducted his own origin and cause analysis for the fire and determined that the fire originated from within the subject gas-fired Frigidaire dryer, manufactured by Electrolux. We have reviewed this report and agree with all of the opinions Mr. Sanderson expressed in his report *(Listed as 1 through 8, pgs. 2-5).* Both the Wright Group

and Fire Findings Investigations have conducted thousands of hours of independent and analysis and testing of burned and unburned Electrolux dryers and have authored nearly identical opinions on the key flaws in the design of the subject designs of the dryers manufactured by Electrolux.

Scott Jones, P.E., of Engineering Investigation, Reports for Electrolux Dryers:

In recent cases, the Wright Group was provided the opportunity to consult with another independent engineer, Scott Jones, P.E., of Engineering Investigation, LLC, who reviewed the data and formed his own opinions involving the Electrolux manufactured dryers that were involved in fires. Mr. Jones is a licensed Professional Engineer and worked for a major appliance manufacturer designing laundry products. In his reports, Mr. Jones determined that Electrolux's design is defective in that lint collects near the heat source and can be ignited by the heat source. Mr. Jones also evaluated the Wright Group's alternative design changes to the Electrolux gas and electric dryers (RONCO 3 & RONCO 4). The following is an excerpt from the Summary of one of his reports: **(For his full reports, see Appendix VIII)**

> *"The present Electrolux laundry center dryer design promotes lint accumulation at multiple locations along the air flow path through the unit. The accumulations present a latent hazard to property and life when the first fuel (particulate/lint) accumulations are ignited by the nichrome heaters. The ensuing fire gains additional fuel from particulate accumulations between the drum and radiant heat shield. The fire is drawn into the drum and the lint filter. The incandescent particulate eventually settles on lint/particulate collection at the blower inlet, which extends the fire throughout the dryer enclosure.*
>
> *The potential for fire can be absolutely eliminated from the present design by isolation of the first fuel (i.e., particulate/lint) from the ignition source (i.e., nichrome heater. Electrolux shifts the burden of isolation to the end user by requiring periodic cleaning of the unit in an unspecified manner by unspecified personnel at unspecified location(s) within the unit. The lay consumer would not recognize the latent danger to life and property inherent in the present design and consequently the design is considered to be defective.*
>
> *As demonstrated by RONCO 3 and RONCO 4 proof-of-concept units, a relatively simple but ingenious design change using concepts, materials and methods that have been known for many years before the production of the present dryer could have prevented the mating of the first fuel and ignition source in the present fire. The proof-of-concept units offer decreased material and production cost to the manufacturer."*

CONCLUSION:

Fire Cause

All fire patterns that were observed on the interior and exterior of the subject appliance indicate that the fire originated within the dryer portion of the Laundry Center. The fire originated from the interior of the dryer and traveled to the exterior of the dryer. The fire patterns, as observed, can only happen if the fire originated at the interior of the dryer spreading to the exterior. The fire patterns do not support any fire spread from the exterior of the dryer to the interior of the dryer. Inspection of the interior of the dryer showed that the fire most probably originated within the area between the heater housing and the rear of the drum. The ignition source was most probably the energized heating element mounted within the heater housing. The first fuel ignited was most probably the lint that had accumulated in this area when it came into contact with the heating element. This burning lint most probably ignited secondary fuels in the dryer, including the lint accumulated in the air path downstream of the drum and the plastic components of the dryer.

This writer has ruled out other ignition sources. All other possible sources of ignition were carefully considered and eliminated. Other sources of ignition considered were:

1. Electrical ignition sources including the motor, wiring, and electrical components were examined and eliminated. There was no evidence of any malfunction of any of the control devices, motor or other components. The electrical activity observed on the internal wiring was determined to be the result of fire attacking the energized conductors.
2. An overheated power supply connection was ruled out because there was no localized heating or electrical activity observed at or near the power cord connections. Additionally, all terminal screws were tight.
3. Ground fault short-circuiting was eliminated as a potential ignition scenario. There was no evidence of arcing between the rear of the drum/baffle and the heating element due to a failure of the rear bearing or contact with the foreign object that had escaped the drum and entered the heater pan.

4. There was no evidence of mechanical failures or frictional heating. The drum pivot and bearing assembly were undamaged. An inspection of the electric motor indicated that there were no signs of any malfunction of the bearings.
5. Contamination of the laundry load was eliminated as the cause of this fire.

In summary, this fire was caused because the design of the dryer actually promotes the accumulation of the combustible material (dryer lint) within close proximity of a competent ignition source (electric heating element).

Over the time of dryer usage leading up to the fire, lint accumulates within the heater assembly and on the rear of the drum in this design of dryer (Ball-Hitch), by chaffing of the clothing against the perforations at the rear of the drum, tumbling action in the drum, etc. It is more probable than not that some amount of this lint became dislodged and was ignited by directly contacting the energized heating element during operation or by accumulating in proximity to the element. While the dryer was operating, the burning lint that ignited behind the drum was pulled into the path of airflow. The burning lint passed into the drum and into the lint filter screen or to the lint built up within the plastic trap duct/blower housing and ignited this accumulation of fuel. Once the smoldering fire ignited the plastic components of the dryer, flames and heat escaped the cabinet and damaged nearby materials around the dryer.

Design Defects and Warnings

Based upon Wright Group, Inc.'s ignition scenario, we have determined the following:

1. **Design:** Electrolux is responsible for this fire due, in part, to its failure to design the hazard out of the subject dryer, its failure to design an engineered guard or safety to prevent or reduce the possibility of fire, and its failure to adequately warn the user of the known fire hazards. If Electrolux had followed the basic safety engineering principles, it would have designed the hazard out of the dryer or guarded against it, instead of solely relying on user instructions to prevent these fire hazards. As outlined in the hierarchy of

safety engineering principles, user instructions are the least preferable method for addressing product safety hazards.

The Ball Hitch design of the dryer is unreasonably dangerous. Heat is required as part of the drying process and lint is a known by-product of the drying process. Electrolux's Ball Hitch design inefficiently manages the lint produced during the drying process and allows for lint to accumulate in areas where it is in close proximity or direct contact with the heat source of the dryer (gas flame in a gas fired dryer, or resistive heating coil in an electric dryer). Other manufacturers' dryers (Bulkhead design) also produce lint, but the lint does not collect at or near the heat sources. Furthermore, the lint that is produced in the Electrolux design collects in areas that are not visible to, or serviceable by, the average user. While a high limit safety device is installed to prevent an overheat condition within the dryer, this ignition scenario does not require an overheat condition and can occur during normal operation of the appliance. There are no safety devices to monitor the accumulation of lint, or to disallow the use of the dryer when excessive lint build up occurs. While improper or inadequate installation or maintenance might contribute to the reduction of airflow and the accumulation of lint, such circumstances should only result in performance problems in a safely designed dryer, not manifest into a fire hazard as in the Electrolux dryer.

As of March 2011, Electrolux produces freestanding dryers using only the Bulkhead style design. Electrolux does not produce any freestanding Ball Hitch style dryers like the subject dryer. The alternative design concept (Bulkhead) was available at the time the subject clothes dryer was manufactured, as other manufacturers have used it for over 50 years. Electrolux's use of the Bulkhead design in those dryers manufactured in their Juarez, Mexico plant, eliminates the possibility lint igniting in the same manner as in the Ball-Hitch design they discontinued using for their freestanding dryers due to the removal of lint collecting behind the drum. Further, this design eliminates rear bearing failure caused fires and foreign object caused fires in all of their freestanding electric dryers due to the relocation of the heating element from behind the drum to within a protective enclosure in the base of the cabinet.

The dryer is further defective because it is constructed using combustible materials. The use of plastic components adds a significant quantity of secondary fuels to the appliance and allows fire to more easily spread out of the cabinet. These plastic components include the plastic lint screen and lint filter housing, the plastic trap duct, the plastic blower housing and fan impeller, the plastic components of the door latch assembly, the plastic door seal and the plastic end caps of the top-mounted control consoles. If the manufacturing materials were constructed of steel, much of the secondary fuel would not be present and any small scale lint fires that do not ignite the load would be contained within the cabinet and burn themselves out. Steel door latches and a woven fire resistant gasket (typically found on oven doors) would greatly improve the possibility that the door would remain closed and the release of smoke, flame and hot gasses from the drum opening would be greatly reduced. While it is our understanding that Electrolux does employ a 5V rated plastic trap duct in some Laundry Centers, the design is only as strong as its weakest link. The use of plastics with flame retardant properties for all of the components, not just the trap duct, would add additional protection against the growth of fire in the cabinet and fire spread from the cabinet. Furthermore, the plastics used in the subject Laundry Center, manufactured in 1992, may not have included any flame retardant plastics.

2. **Warnings:** The warnings on the dryer do not advise the user that lint collects near the heat source and can be a fire hazard. This lint collects in areas where the user cannot observe it. While the Installation Guide contains recommendations for the installation of the appliance and the User's Guide makes recommendations for periodic maintenance, it is foreseeable that the user will not follow those recommendations. Even "professional" installations of dryers by the sellers of these appliances are not always done according to the installation instructions, and the end-user may be unaware that the appliance was not installed according to the manufacturer's recommendations. Instruction manuals may be misplaced, or may not be included with the appliance if it is purchased used, such as in a case where the appliances are included as part of a home sale. Electrolux violated basic safety engineering principals by choosing the least preferable method to warn users of the

fire hazards, as set forth in the Safety Engineering Hierarchy. As discussed in the section of this report concerning the design defects, a safety device such as a warning lamp could be provided to indicate when professional service is required, and could further include a lockout feature if the warning was ignored.

Based upon these opinions, it is the Wright Group's conclusion that the design of this dryer is unreasonably dangerous and allows for fire ignition to occur. Fuel (lint) and a heat source (electric heating element or gas burner flame) are brought together in the presence of an oxidizer (air). Once these first fuels are ignited, they then spread to secondary fuels (the laundry load, additional accumulations of lint in the lint screen/trap duct assembly and to the numerous combustible plastic components). There is no engineered guard or safety to separate the typical first fuels (lint) from the heat sources. Also, warnings as to the risk of fire are non-existent on the appliance itself as they relate to the hazard associated with the collection of lint behind the drum at the heat source, where it cannot be observed or removed by the user. Once a fire occurs, the fire will not be contained due to the prevalent use of plastics with no fire retardants.

Electrolux is responsible for this fire due to its use of a defective design, its failure to re-design the dryer to eliminate the hazard or to design an engineered guard or safety to prevent or reduce the possibility of fire, and its failure to warn the user of the known fire hazards. If Electrolux had followed the basic product safety principles, it would have designed the hazard out of the dryer or guarded against it, instead of solely relying on user instructions to prevent these fire hazards. As outlined in the hierarchy of safety engineering and product safety principles, user instructions are the least preferable method for addressing product safety hazards. Even if one was to accept Electrolux's expected allegations that the dryer was not properly installed or maintained, Electrolux should have used a safeguard in the form of a cycle counter to force users to have the dryer professionally maintained, with lint removed from the heat source area, every 18 months. Additionally, Electrolux failed to use proper materials in their ball-hitch dryers, thus adding unnecessary fuels within the cabinet and allowing fires to escape containment. They made this decision to use the cheapest plastics with the lowest fire resistance rating instead of metal or even plastics with higher fire resistance rating, even though fire containment testing they performed allowed fire to escape the cabinet.

Any allegations as to the insureds' actions contributing to the fire in respect to improper installation would be unfounded. The insured did not install the dryer. The dryer was sold to them by Kennedy and Hahn, a major distributor of Electrolux appliances in the area, which also provided the insured services for delivery and installation of hundreds of similar units throughout the Blake Capital properties. The dryer was not installed according to the Installation Instructions was because the installer used a section flexible foil transition duct, that was trimmed to its shortest possible length. However, Electrolux's own documents indicate that in 2000, years prior to the date of manufacture of the subject dryer, they were aware that most installers were using flexible foil ducts to install clothes dryer. Variations throughout Installation Instructions throughout the years permit the use of flexible foil transition ducts in other models of these same Ball-Hitch dryers. Furthermore, Electrolux distributed flexible foil transition ducts for use on all dryers until approximately 2009, until instructed by their legal department that they should no longer distribute the same foil ducts they recommend against using.

Additionally, there was no reliable information that the venting was restricted in any way. Dennis Dyl, the expert who conducted the fire scene inspection reported that the duct system for the subject Laundry Center was tested by Engineering Systems, one of Electrolux's forensic consulting experts who have investigated hundreds of dryer fires on their behalf. The backpressure measurement ESI obtained was 0.54 to 0.57 inches of water column. This was well below the maximum allowable backpressure of 0.75 inches of water column allowed in Electrolux's Installation Instruction. While arguably, the flexible foil duct could not have been connected at the time the backpressure measurement was recorded, it is improbable that the arrangement of the venting behind the appliance would have caused the backpressure measurement to exceed 0.75 inches of water column.

Additionally, any allegations as to the insured's actions contributing to the fire in respect to improper maintenance or misuse are also false. The hundreds of laundry Centers owned by Blake capital are installed in multi-unit apartment buildings and operated by tenants. The insured did not operate the dryers but did supply tenants with the operational instructions. The property where the fire occurred employed full time maintenance staff who would conduct basic

trouble shooting on any appliance if complaints were received by any of the tenants. It was their common practice to hire the local distributor to conduct any substantial repairs or replace the non-functioning units. Furthermore, Electrolux's expectation that the interior of the dryer cabinet should be professionally cleaned approximately every 18 months is unreasonable. According to the survey conducted by the Consumer Products Safety Commission' 2010 Consumer Opinion Survey on Clothes Dryer Installation and Maintenance, most users do not have the interior of their dryer cabinets cleaned approximately every 18 months by qualified personnel, unless it is performed during a service call for a recognizable issue they are experiencing with their appliance.

It is our opinion to a reasonable degree of scientific certainty that this dryer was defective in its design as set forth in this report, and that the defects in the dryer were the proximate cause of the fire. At this point, our examination of the dryer and report on our findings are complete. We reserve the right to modify or supplement this report if we receive documents after December 20, 2013 that provide additional information.

Sincerely,

Ronald Parsons
Fire Analyst

Michael R. Stoddard, Jr.
Fire Analyst

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